Nail biting and related health issues: Perspectives of health professionals and nail biters

by

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Abstract

Nail biting is a common oral habit, which is usually considered as developmental and harmless. In severe cases, from a health perspective, nail biting may lead to health problems such as skin infections or minor tissue damage, dental issues, bacterial infection, and alveolar destruction. However, in many societies, nail biting is frequently not taken seriously as a pathological condition, and this may increase the possibility of the emergence of serious health issues. In terms of causes and treatment measures for nail biting, there has been an extreme lack of research evidence, especially in the medical literature. In an attempt to cast more light on this under-investigated issue of nail biting, the present study was conducted with a special focus on its possible causes, associated health problems and treatment methods from the perspective of nail biters, parents of nail biting children and health professionals.

The research endeavoured to seek answers to the following research questions.

1. What are the views of nail biters and parents of nail biting children in Tasmania, Australia on the possible causes, associated health issues, and treatment of nail biting?

2. What are the views of Australian health professionals on the possible causes, associated health issues, and treatment of nail biting?

3. What are implications and recommendations for Australian parents and health professionals in dealing with nail biting among children?

A mixed methods design was utilised in the present study, with the use of questionnaires in the quantitative phase and semi-structured interviews in the qualitative phase. Regarding the questionnaires, data were collected from a total of 145 participants, including 65 health professionals and 80 nail biters or parents of nail biters. For the semi-structured interviews, the sample consisted of 23 past and current nail biters, and 14 health professionals.

In terms of causes of nail biting, it was found that psychological imbalances, such as stress, anxiety and nervousness, were perceived as the principal cause of nail biting, followed by nutritional deficiency. With regards to associated health problems, infectious diseases ranked top, and dental issues ranked second. The study also revealed that bitter nail polish and mineral supplements were highly recommended for treatment by nail biters, parents of nail biting children and health professionals. The study's findings have a number of practical implications and considerations for nail biters, parents of nail biting children, and health professionals in relation to the prevention and treatment of pathologic nail biting.

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Abbreviations

ADHD:	Attention deficit hyperactivity disorder
CAMP:	Cyclic adenosine monophosphate
CNS:	Central nervous system
CP:	Calcium phosphate
DE:	Diatomaceous Earth
KP or PP:	Potassium phosphate
HPs:	Health practitioners/professionals
IBS:	Irritable bowel syndrome
MP:	Magnesium phosphate
NB:	Nail biters
NBP:	Nail-biting patients
NT:	Neuro-transmitter
ODD:	Oppositional defiant disorder
OCD:	Obsessive-compulsive disorder
OSA:	Obstructive sleep apnea
PPMP:	Celloid potassium phosphate and magnesium phosphate
RCT:	Randomised controlled trial
RBC:	Red blood cell count
SAMe:	S-adenosyl methionine
STC:	Schuessler tissue salts

1 Introduction

1.1 Introduction

Nail biting is a common oral habit, which is usually considered as harmless. Despite the fact that it does not typically cause any serious impairment, in severe cases, nail biting may cause health problems such as skin infections or minor tissue damage (Libretto, 1999), dental issues (Hodges, Allen, & Durham, 1994; Krejci, 2000) and bacterial infection and alveolar destruction (Tanaka, Vitral, Tanaka, Guerrero, & Camargo, 2008). Nail biting is also linked to some co-morbid psychiatric disorders (Ghanizadeh, 2008). However, as suggested by Ghanizadeh and Shekoohi (2011), nail biting is frequently not taken seriously as a pathological condition, which may lead to otherwise preventable health issues. In a bid to cast more light on this under-investigated issue of nail biting, the current study was conducted with a special focus on its possible causes, associated health problems and treatments from the perspective of parents of Australian nail biters and Australian health professionals.

The purpose of this chapter is to provide an overview of the study by highlighting the research and contextual background associated with nail biting. In addition, the chapter emphasizes the study significance as well as the research aims and questions. It also outlines the methodology, ethical considerations, and the contents of each chapter.

1.2 Nail biting: Definition and prevalence

Nail biting (NB) is a common behaviour disorder noted in children and teenagers (Tanaka et al., 2008). Nail biting is scientifically named onychophagia which is derived from the Greek words “onychos” meaning nails and “phagein” meaning to eat (Arora, Saneja, & Pathak, 2010; Tanaka et al., 2008). An operational definition of NB is “putting one or more fingers in the mouth and biting on nail with teeth”

(Teng, Woods, Twohig, & Marcks, 2002). In other words, it is the practice of frequently chewing off one's fingernails. Historically, the earliest reference to nail biting was recorded in the late sixteenth-century by a French scientist, Monsieur De Lisle quoted in Williams (2010), who described nail biting as a nervous habit often associated with anxiety (Williams, 2010).

Although nail biting is a common behaviour disorder, there are scanty scientific studies on its prevalence. The currently available data of its prevalence vary across different studies. As observed by Ghanizadeh (2011), reports of nail biting prevalence are sometimes contradictory. However, a common documented observation is that habitual nail biting is prevalent in children and adolescents (Christmann & Sommer, 1976) and often lingers into adulthood (Ballinger, 1970).

The prevalence rate of nail biting among children and adolescents across countries has been reported to range from 12.0% to 45.0%. Seeking to establish the prevalence of nail biting habit, Odenrick and Brattstrom (1985) conducted a research with the participation of 1025 children in Portugal. They found that the habit of frequent nail biting was reported among 14.3% of the whole sample. On a smaller sample of 340 questionnaire respondents, nail biting was reportedly a habit of 45.0% of the children. In 1998, an epidemiological study conducted upon 4,590 school children by Shetty and Munshi (1998) identified the widespread of nail biting in Mangalore, India.

The average nail biting prevalence in reviewed studies hovers around the 20.0 - 29.0% range. Gavish, Halachmi, Winocur, and Gazit (2000) reported that a proportion of 25.5% of a total of 248 girls aged 15-16 years were nail biters. With a similar view to investigate the habit of nail biting among children, Ooki (2005) conducted a large-scale study, involving a total of 1,131 pairs of 12-year-old twin children in Japan. Findings from maternal questionnaires and medical interviews indicated that nail biting was prevalent among 28.0% of the males and 26.0% of the females. Likewise, a research on 385 Saudi Arabian school children aged 12 - 16 reported 29.0% of the sampled population were nail biters (Feteih, 2006).

In a later effort to determine the prevalence of adverse oral habits among children in India, Hedge and Xavier (2009) found that nearly 20.0% (19.95%) of a total of 2,636 children aged 4 - 15 in the areas of South Kanara district were victims of those oral habits with nail biting being the most prevalent one (44.1% of the 526 students victimised by adverse oral habits). More recently, Ghanizadeh and Shekoohi (2011) conducted a study to evaluate the prevalence of nail biting by surveying the parents of 743 primary school children in Shiraz, Iran. It was found that 22.3% of the girls and 24.4% of the boys had nail biting behaviour in the last three months.

These reported rates are also consistent with the dental literature on oral habits with a nail biting prevalence of 25.5% (Kharbanda, Sidhu, Sundaram, & Shukla, 2003). In Farsi's study to record the prevalence of oral parafunctional habit among 1,940 stratified randomly selected school children, nail biting was reportedly the most common oral parafunction (Farsi, 2003). Similarly, Al-Atabi (2014) revealed a high proportion of nail biters (23.4%) among a large sample of 3,300 students in Baghdad, Iraq, which rendered nail biting the most prevalent among the habitual disorders under study, including tongue thrust, digit sucking, mouth breathing, lip habit and others.

There is an indication from the literature that nail biting prevalence is correlated with age (Farsi, 2003). However, the variation patterns by age have been reported to be different among early and more recent studies. For example, Wechsler (1931) found that 44.0% of children at the age of around 13 were nail biters, whereas Malone and Massler (1950) reported 35.0% and Deardoff and colleagues (1974) reported only 12.0% at a similar age. Notwithstanding, the common finding among these early research studies was that the prevalence of nail biting tended to peak in early childhood and seemed to start declining during the teenage period. In the same vein, Foster (1998) stated that nail biting was associated with age, and its prevalence decreased with the increase of age.

On the other hand, a different pattern has been found in more recent studies, whereby the prevalence of nail biting is more likely to increase during teenage years and decline in adulthood. Leung and Robson (1990) were among the first

researchers to identify this trend with the finding that nail biting affected around 30.0% of children aged 7-10 and 45.0% of teenagers in Alberta, Canada. Their finding was later supported by Peterson, Campise, and Azrin (Peterson, Campise, & Azrin, 1994), who found that nail biting prevalence increased with age during childhood, peaking at approximately 45.0% during adolescence, and then decreased during adulthood to approximately 4.5% with females engaging in nail biting more than males. Four years later, an epidemiological study among 4,590 school children in Mangalore, India by Shetty and Munshi (1998) also found nail biting to be more common in the teenage age group of 13 - 16 years old than any other age groups.

According to the review of Sachan and Chaturvedi (2012), nail biting is largely prevalent between the ages of four and six, stabilising in the following three years before remarkably re-emerging during the notably traumatic and crisis period of adolescence. As observed by Tanaka, Vitral, Tanaka, Guerrero, and Camargo (Tanaka et al., 2008), the incidence of nail biting in children aged four to six years was higher than earlier ages while it increases in adolescence and eventually decreased in later ages. In some cases, nail biting eventually stops towards adulthood, but unfortunately, this serious condition can still persist to adulthood. For example, Siddiqui, Naeem, Naqvi and Ahmed (2012) performed a cross-sectional study among a convenience sample of 210 medical students in Karachi, Pakistan using a pre-tested tool called the Habit Questionnaire. The overall prevalence of nail biting was found to be 6.2% whereby all nail biters were involved in the habit five times or more per day for a period of at least four weeks.

In summary, nail biting is most frequently observed in the age groups of early childhood and adolescence. Its prevalence rate ranges from 12.0% to 45.0%, clustering around 20.0% – 29.0%.

1.3 Emerging issues related to nail biting

Excessive nail biting could lead to a series of negative consequences, including serious deformations of nails and a list of digestive complications (Baran et al., 2003). Nevertheless, the serious conditions underlying nail biting are not well

recognised in the medical field and are therefore not addressed properly. As nail biting has received little attention in medical literature, preventative measures are vague and not substantially supported by research evidence.

Some of the most prevalent nail biting complications are linked to dental risks, such as chronic swollen gums, infected gums and periodontal traumatic injuries (Creath, Steinmetz, & Roebuck, 1995; Feteih, 2006; Sousa, Pinto, Araujo, Rego, & Moreira-Neto, 2010). Other forms of injuries are also associated with nail biting, including but not limited to acute paronychia (infection of the nail fold), craniomandibular dysfunction, and a range of infections such as cold and flu viruses, bacteria and Osteomyelitis (Fuqua & Brosh, 2006; Tosti, Peluso, Bardazzi, Morelli, & Bassi, 1994; Waldman & Frieden, 1990; Westling, 1988).

Besides the physiological effects, nail biting is reported to be linked with certain psychological and psychiatric factors. A study of a community sample of children from Shiraz, Iran, provides some insights into the underlying psychopathological problems associated with nail biting (Ghanizadeh, 2011). A finding from the literature reveals that nail-biters tend to suffer one or more psychiatric disorders (Ghanizadeh, 2008). Some social issues, such as prosocial ability in children, are also reported to be connected to the notorious nail biting habit.

1.4 Statement of problems

The consequences of nail biting range from mild to serious clinical distress and functional impairment. Children with nail biting problems are often seen by paediatricians, psychologists or psychiatrists (Peterson et al., 1994). Albeit with many associated complications in serious cases, nail biting is largely dismissed as a minor nuisance and easily ignored. It is perhaps because nail biting is a non-threatening common disorder in most cases, and it is still an under-recognised health problem, which warrants further research. According to Ghanizadeh (2011), one possible reason for the lack of success in the management of nail biting is the lack of consideration of nail biting as a symptom of a more complicated condition. Ghanizadeh (2011) viewed nail biting as one symptom from a cluster of symptoms,

which should be evaluated, assessed and managed, along with the motivation behind nail biting.

The causes underlying nail biting are not well understood in the medical field and are therefore not addressed properly. In terms of research and preventative measures for nail biting, there has been a large gap in the current literature. Both nail biting and pica are habit disorders; however, only the association between pica and mineral deficiency have been examined and clinically studied, whereas the possible correlation between nail biting and mineral deficiency are under-examined and under-researched. Bohne and his colleagues (2005) reviewed the up-to-date research findings on nail biting as a form of pathologic behaviour, and suggested that further research is needed regarding the aetiology of pathologic nail biting to develop effective and long-lasting treatments and preventative measures. In the same vein, in his review of research evidence related to nail biting's aetiology, consequences and management, Ghanizadeh (2011) concluded that nail biting cannot be managed without considering its co-morbidities, antecedents and consequences.

Despite the seriousness of the nail biting consequences in some cases, there is a lack of awareness among parents, children and the public in general into the associated risks as well as the preventative and corrective measures for nail biting. For example, Hedge and Xavier (2009) found that 77.8% of a total of 2,636 students in South Kanara, India were unaware of the potential hazards caused by the adverse oral habit on one's wellbeing. In addition, 16.2% were unaware of the importance of basic body cleanliness and adverse general health practices were quite prevalent at various degrees, ranging from 0.3 to 45.0%. Emphasising the need for enhanced public awareness of this potentially detrimental behavioural disorder, Ghanizadeh (2011) stated, "Any treatment should be accompanied by educating the afflicted children as well as their parents, siblings and teachers. They should be taught about what to do and what not to do about it." (pp. 75-76)

Another factor that justifies the conduction of this study was the complete absence of research peer reviewed publications regarding the issue of excessive nail biting in

Australia. Given the significance of the issue and the emergence of research interest elsewhere this gap is surprising. The lack of research publications may indicate a shortage of research-based activities or a lack of concern about this issue, resulting in a knowledge gap that needs to be filled. Without proper examination and assessment of the causes and related health risks of nail biting, it is hard to determine the need to implement appropriate effective preventative and corrective treatments. Therefore, it is imperative to conduct research on nail biting in Australia to gain better understanding about this under-studied habitual disorder.

All of these rationales have given rise to the need for more research about nail biting, especially in relation to the possible causes, associated health consequences and valid treatments for this habitual oral disorder. This study is especially worthwhile in the context of Australia, where recent research into nail biting is difficult to identify. Findings from this investigation are expected to build the premises on which practices to prevent and cure pathological nail biting operate.

1.5 Research aims and research questions

Taking into consideration the research and contextual backgrounds, the issue of nail biting is of crucial significance and more research is urgently needed to fill in the current knowledge gap in Australia. The aim of this research study is to examine the views of Australian parents and Australian health professionals on children's nail biting in social, psychological and clinical dimensions. Specifically, it investigates the perceived causes, health risks, and treatments for nail biting among children, with a special focus on the relationship between mineral imbalances and nail biting. The use of mixed methods of quantitative and qualitative analysis was considered to be appropriate for this study to achieve the aims.

The research study endeavours to seek answers to the following research questions:

1. What are the views of nail biters and parents of nail biting children in Tasmania, Australia on the possible causes, associated health issues, and treatment of nail biting?

2. What are the views of Australian health professionals on the possible causes, associated health issues, and treatment of nail biting?

3. What are implications and recommendations for Australian parents and health professionals in dealing with nail biting among children?

1.6 Study significance

1.6.1 Contribution to knowledge

The current study is significant in the sense that it addresses an issue where there has been a shortage of research. The majority of research studies found on nail biting have been conducted and published outside Australia (See more details in Chapter 2 about literature review). A comprehensive review shows that no studies similar to the current one have been conducted in Australia or with Australian participants. Grounded on the absence of research-based evidence, this study's significance is contextually justified.

In addition, most studies on nail biting have linked this habitual oral disorder to other psychological issues. This study instead strives to examine nail biting through a more holistic lens, albeit with special respect to the relationship between mineral imbalances and nail biting. While there has been great interest among health professionals about the role of minerals in nail biting management, particularly in terms of health; there is a huge gap of research in this area (as indicated further in the literature review). To cater for the public interest, the commercial world has developed some information sources to accommodate public attention and health practitioners. There is a strong belief from health and natural practitioners about the role of minerals in nail biting treatments. Therefore, its findings would contribute to knowledge and understanding about nail biting in relation to its possible causes, consequences, and treatments.

Finally, this study uses a mixed methods approach where both qualitative and quantitative methods are combined so that the insights gained from the findings are rich in statistical presentations and personal experiential meanings. While the

quantitative data analysis identifies some important variables and their statistical relationship, qualitative data analysis focuses on the voices of the participants which represent their concepts, views, attitudes and meaning in relation to nail biting in terms of social and psychological manifestations as well as health behaviours.

1.6.2 Potential benefits to various agents

Firstly, nail biters will benefit most from enhanced awareness of the causes, consequences and treatments of nail biting. Generally thought of as a harmless habitual disorder which should be self-regulated and self-corrected, nail biters are usually left to grow out of this habit without interference from parents and health professionals. However, it should be noted that excessive nail biting entails a series of serious health problems that require treatment as a pathological condition (Ghanizadeh, 2011). Being more conscious of nail biting's health consequences, for example, nail biters would develop an appropriate attitude towards this habitual disorder and a higher motivation to modify their behaviours. It is expected that nail biters would make well-informed choices as to whether or not to quit nail biting and how to do that.

Secondly, the study's findings would be beneficial to parents and health professionals. Improved knowledge of nail biting in terms of its perceived causes, consequences and treatments, as well as its possible correlations with various factors, would facilitate parents' and health professionals' role in assisting nail biters and increase the treatment efficiency of nail biting. As the treatment of nail biting usually requires a concerted effort from different agents, understanding of the perceptions and views on nail biting among one another would also aid the treatment process. For example, being better informed by the study results, nail biters, their parents and health professionals may make some adjustments to their own beliefs and treatment practices to reduce the possible mismatch in their coordinated effort against nail biting. The study findings may also warrant further negotiations between nail biters, parents and health professionals to seek a more effective approach to nail biting treatment. As a whole, increased awareness of the

perceived causes, observed consequences and recommended treatments for nail biting would enable parents and health professionals to play a more effective role in treating nail biting.

1.7 Methodology

1.7.1 Research design

It first appears that positivism and social construction are two opposing perspectives in research methodology as the former is based on the principle of scientific objectivity, with the support of statistics in pursuit of accuracy; whereas the social construction perspective holds the view that human world is too complex to be precisely measured and objectively interpreted. Thus, research tends to choose one perspective instead of the other in a study. However, these two perspectives should not be treated as mutually exclusive. Instead, they can be used to complement each other as each has its own strengths and weaknesses. A combination of two perspectives can provide different insights about the complexity of human behaviour and social realities. It is important to ensure that in a study using both quantitative and qualitative methods, researchers should not inappropriately use the criteria and tools in one method for the other in dealing with different kinds of research data.

A mixed methods design was utilised in the present study to obtain a comprehensive understanding of the current perceived causes, effects and treatments of nail biting from the perspectives of both parents and health professionals. It was believed that the use of combined data collection methods, including both quantitative and qualitative data, would capture both the breadth and the depth of the issue under study. Mixed methods approach has been highly recommended for issues with a high level of complexity (Creswell & Plano-Clark, 2007; Greene, 2006), which made it most appropriate for the investigation of the multi-dimensional issue of nail biting.

Questionnaires were used in the quantitative phase and semi-structured interviews were used in the qualitative phase. These two instruments had different focuses

and natures although they were designed to investigate the same issue of nail biting. Therefore, the concurrent mixed methods approach or triangulation was used in which the quantitative data and qualitative data were collected roughly at the same time and merged during the interpretation phase.

1.7.2 The sample

- *For the questionnaire survey*: With the permission and support from the third parties (e.g., Pharmacy network, Medical Practices, Schools, Community Health Services etc.), the survey questionnaire were available in hard copies at the reception areas of these places. A drop box was provided in each location for completed questionnaires. Alternative on-line survey delivery was considered for maximising the responses rate. The online version was designed and collected by the Survey Monkey website (SurveyMonkey, 2013). Participants in the research were also be recruited using multiple media strategies, such as flyers in each location, phone calls, conferences/seminars, mailing list and/or social networking. Quantitative data were collected from a total of 145 participants, including 65 health professionals and 80 nail biters or parents of nail biters.

- *For the semi-structured interviews*: Follow-up interviews were conducted to gather qualitative information about nail-biting and its related health issues. Survey participants were asked to indicate on the returned survey form they are willing to be contacted for a 20-30 minute follow-up interview. A convenience sample (up to 30 volunteers per participating group) of those consenting was selected for interviews. The researcher then arranged with each of them a time and a location for an interview. The final sample consisted of 23 past and current nail biters, and 14 health professionals who reflected the diversity of backgrounds. These interviewees provided richer and more in-depth textual information on issues related to the causes, effects and treatments of nail biting.

Further information about recruitment of participants was detailed in Chapter 3 – Research Methodology.

1.7.3 Instruments and data analysis

A summary of research instruments together with corresponding data analysis is provided below (further details can be found in Chapter 3).

Table 1-1: ***Summary of instrument and data analysis***

Research questions (RQ)	Instruments	Analytic procedures
1). What are the views of parents on: **- Possible causes of nail biting (with some reference to mineral imbalances);** **- Associated health issues of nail biting; and** **- The treatment of nail biting?** **2). What are the views of health professionals on:** **- Possible causes of nail biting (with some reference to mineral imbalances);** **- Associated health issues of nail biting; and** **- The treatment of nail biting?**	Questionnaire survey	**Quantitative data analysis of participants' responses to the questionnaires was conducted using Descriptive Statistics (such as frequency, mean, median and Standard deviation). To aid the analysis of data, the Statistical Package for the Social Science (SPSS) software was used.**
3). What are implications and recommendations for parents and health professionals in dealing with children with nail biting?	Semi-structured interviews	**Qualitative data analysis was undertaken on semi-structured interview transcripts using thematic analysis to identify codes, categories and themes.**

A questionnaire for parents and another one for health professionals were developed based on a rigorous review of the literature, consultation of experts in the field, and a pilot test to ensure its validity and reliability (for further details regarding the construction of the questionnaire, see Chapter 3).

The questionnaire for parents composed of 17 items divided into two main sections. Section A covered three items of general questions about the child, such as age, body weight, body height, and whether the child was a past or current nail biter. Section B included a range of questions related to the nail biting habit and health status of the nail biting child. Specifically, they were related to the duration and

frequency of the child's nail biting habit; the perceived most common cause of nail biting; the nail biting related health problems suffered by the child; the utilized treatment methods and their effectiveness; the child's diet preferences; current medications or supplements taken by the child; the child's co-occurring health issues diagnosed by doctors; and possible social issues experienced by the nail biting child. At the end of the questionnaire, an open-ended question was included to invite for parents' further comments and suggestions.

The questionnaire for health practitioners consisted of seven items that aimed to explore their views and experiences in dealing with nail biting among children. Specifically, the questions were related to their profession (medical doctor, pharmacist, naturopath, or others); their perceived most probable cause of nail biting; observed health issues and disorders of nail biters; and recommended treatment methods.

Semi-structured interviews were concurrently used as a qualitative instrument of the study to aid questionnaires in discovering richer and deeper information relating to the issue of nail biting. Semi-structured interviews were used instead of structured interviews because they allowed for a higher flexibility in approaching the issue and created opportunities for new issues to arise along the way. The data from the interviews with the nail biters, parents of nail biters, and health professionals, provided further insights into the individual differences in terms of perceived causes, effects, and treatments of nail biting. Many of the themes that emerged from the different groups of participants were compared and combined to highlight and reinforce identified themes.

1.8 Ethical considerations

The present research was granted full ethical approval (Ethics Reference No: H12056) by the Human Research Ethics Committee of the University of Tasmania, Australia (See Appendix 1).

The principles of ethics govern the conduct of research in various settings. Ethics are meant to offer guidelines in relation to the rights, dignity and safety of human

subjects, and to monitor the integrity of the research enterprise (S. Cox, Townsend, Preto, Woodgate, & Kolopack, 2009). In dealing with human beings researchers need to conform to the highest standards of ethical practice (Australian Goverment, 2007). As dictated by the National Statement on Ethical Conduct in Research Involving Humans (Australian Goverment, 2007), researchers are to observe the four guiding principles of integrity, respect for persons, beneficence and justice, which are detailed in the National Statement (p. 12). The following sections provide an account of how these principles were observed and conformed to in this present research study.

Firstly, the principle of integrity refers to a commitment to the search for knowledge, to recognised principles of research conduct and the honest and ethical conduct of research and dissemination and communication of results. This principle requires every research effort in a given area to aim at the discovery and contribution of new knowledge. During this research study, the researcher maintained a high level of objectivity and honesty in every step of the whole process of collecting data, analysing data and communicating findings. Collected data were processed without interference from any individuals and appropriate measures were taken to ensure that bias was eliminated from the analysis and interpretation of the findings.

Secondly, the principle of respect for persons is related to the welfare, rights, beliefs, perceptions, customs and cultural heritage, both individual and collective, of persons involved in research. Specifically, this principle requires that each research protocol must be designed to ensure that respect for the dignity and wellbeing of the participants is the top priority. In the present study, the researcher had taken all possible procedures to guarantee the privacy of the participants, the confidentiality of any disclosed information, and consent in participation. In particular, the participants, including past and present nail biters, parents of nail biters, and health professional, were fully informed of the purpose and aim of the study and invited to consent to participation. The participants were mentally and physically healthy individuals, who were capable of making voluntary decisions as to whether to participate and give responses based on their own thoughts. As indicated clearly in

the Information sheet and Consent form, the participants had the right to withdraw their participation at any time without having to give an explanation. Regarding confidentiality, the survey questionnaires were anonymous and the questionnaire participants' data were non-identifiable. All of the completed survey questionnaires have been stored in locked filling cabinet, which will be destroyed after a period of five years from the close of the study. As for the interview data, the researcher coded all of the transcripts and treated them in a confidential manner with no real names included in any publications of the research.

Thirdly, the principle of beneficence points to the researchers' responsibility to minimise risks of harm or discomfort to participants in research projects, and finally, the principle of justice dictates that there is a fair distribution of the benefits and burdens of participation in research and, for any research participant, a balance of burdens and benefits. These two principles were mindfully observed in this present research in several ways. For example, care was taken to ensure the security and safety of all involved participants and all possible harm was eliminated in every stage. The focus of the research was about the perceived causes, effects and treatment of nail biting, so there were no sensitive, personal or cultural issues that could offend or create any distress on the part of the participants.

1.9 Thesis structure

The thesis is divided into seven chapters, which are structured to provide a detailed account of the research study from the beginning to the end and what has been done to achieve the research aims and objectives. Specifically, it provides a comprehensive discussion on the contextual and conceptual framework underpinning the study, the methodological design of the study, the findings, and discussion pertaining to the research focus on nail biting causes, related health risks and treatments.

An outline of each chapter is presented below.

- **Chapter 1 – Introduction**: This chapter provides a background for the study with an overview of the rationale, and purpose of the research. It also

outlines the research aims and questions that provide the framework for the research. In addition, it includes a brief description of the methodology and the ethical considerations.

- **Chapter 2 – Literature review**: This chapter provides insights into the causes, effects and treatments of nail biting as reported in the literature. Relevant theories, especially those regarding mineral imbalances, are discussed to provide a better understanding of the research issue. Gaps in the field are highlighted where appropriate.

- **Chapter 3 – Methodology**: This chapter describes the research framework, which was designed to address the research questions. Specifically, it provides a detailed description of the research tools, the participants, the data collection, data management and data analysis. The choices of research approaches are also justified.

- **Chapter 4 – Quantitative data analysis and results**: This chapter presents the quantitative data collected from the nail biting questionnaire for both parents and health professionals with statistical presentations of results in tables and charts.

- **Chapter 5 – Qualitative data analysis and results**: This chapter presents the qualitative data sourced from the interviews conducted with the health professionals and parents as well as the written comments from the questionnaire.

- **Chapter 6 – Discussion and Conclusion**: This chapter discusses the results of the quantitative and qualitative data analysis in relation to the study's research questions and with reference to the related literature review. Possible explanations for certain patterns, views and phenomena are also provided where appropriate.

  This chapter also revisits the main research findings, their significance and implications. In addition, it discusses the study's strengths, its limitations and

future directions for research regarding nail biting. The chapter concludes by providing a number of recommendations for the prevention and treatment of nail biting, especially among children and teenagers. Finally, personal reflection of the researcher will be included to mark the end of her research journey. Reflection plays an important role in qualitative research as it is based on the view that researchers' personal backgrounds and world views directly or indirectly affect their adopted research journeys. This is the reason why a comprehensive presentation of the researcher's reflection is included in the final chapter of this study.

1.10 Conclusion

As a general introduction to the present study, this chapter has provided an overview of the thesis by introducing the background and the context in which the study was conducted. The purpose and the significance of the study have been highlighted through the statements of problems, followed by the research aims and questions. In addition, the research methods and ethical considerations have been briefly described. Finally, the thesis structure was outlined with a brief overview of each chapter. As a whole, Chapter 1 consists of the fundamental information to lay a firm foundation for the following chapters. The following chapter contains an extensive review of the literature concerning nail biting with a focus on its highly documented causes, effects and treatments. Related concepts and theories, upon which the study was based, are also discussed.

2 Literature Review

2.1 Introduction

The significance of literature review in research should not be underestimated as it provides a landscape in which a study is situated. It reveals the current research knowledge in the relevant field and the issues which have been dealt with and research problems which need further investigation. Without a well-informed literature review, it is impossible to establish a proper research plan with well-defined aims, objectives and research questions. Thus, there are also implications on the choice and use of research methodology and the contribution of a study to the research field.

The purpose of this chapter is to provide a comprehensive review of the literature in relation to nail biting, which has been conducted and published by researchers worldwide. To provide a clear account of what has been done in the process, research findings are compiled and organised thematically. The chapter starts with a synthesis of research findings related to the documented causes of nail biting, its possible effects, symptoms or comorbidity, and various treatment approaches. It then continues with some theoretical discussion surrounding the habitual disorder of nail biting. Major research studies with a focus on these themes are analysed, compared and contrasted in this chapter, providing a solid theoretical and scientific background for the study. These reported research studies have been found to be both exploratory/descriptive and experimental, which offers a fairly complete depiction of the issues under study. This chapter also highlights the gaps in the field where appropriate to identify the needs for and the significance of the present study.

A comprehensive search for empirical literature was conducted from several resources. Firstly, a review was conducted on traditional resources, including books, journals, and other published documents collected by several university libraries

and the National Library of Australia. Secondly, a search was carried out on electronic databases and aggregators, such as ProQuest, PubMed, Medline, Academic Search Premier, Informaworld, Cochran Library, Google Scholar, Cross Search, etc. to obtain the relevant research findings in this research field. Key words for searching included nail biting, nail biters, onychophagia, oral habitual disorder, nail biting in children, mineral deficiency and nail biting, psychological disorders and nail biting, nail biting and treatments, mineral therapy, mineral status analysis, children and nutrition deficiency, common mineral deficiency in children, etc. Similar searches were also conducted using Google Scholar and Cross Search through the University of Tasmania's library for generic literature related to the issue. Moreover, the researcher also scanned the reference lists of the acquired research papers to identify other studies that were not included in the databases. The selection criteria for the review included all of the primary research studies on this topic of interest, which were of either quantitative and qualitative approaches or both, either exploratory or experimental or both, and were original works published in English. As a whole, the literature review includes published documents from 1925 to 2015. Apart from the initial search at the beginning of the research journey, periodical searches and reviews of the relevant literature were continuously conducted throughout the three-year period to ensure the latest research findings were captured in the present study. It should be noted that a number of literature review items, which appeared as 'outdated', are mentioned in this literature review chapter. It indicates firstly that there is a huge gap of research in this area; and secondly that there was interest in it in the public even though research did not pay serious attention at that time.

2.2 Nail biting risks and complications

Nail biting, like other behavioural issues, falls along a continuum from a mild, occasional behaviour with minimal impact to a frequent, intense, and disfiguring clinical manifestation. For individuals affected by a high rate of fingernail biting, there can be serious impact (Waller, Kent, & Johnson, 2007). For example, according to ninemsn news on the 12th March 2014, a British famous former

football referee, John Gardener, 40 years old, suddenly died from a heart attack caused by his nail biting habit. He was a severe nail biter, obsessively biting till bleeding. The bleeding from his fingers consequently led to his fatal blood poisoning infection (septicaemia). Moreover, one of his fingers was amputated 2 weeks before he died, which was also caused by his nail biting problem (Crossley, 2014). On the news, his mother wanted to warn every nail biter to take nail biting seriously. This fatal incident indicates that nail biting habit is no longer considered just as "a casual habit" as many parents, people and health professionals believe. There are many documented health problems related to nail biting and co-occurring disorders (Chevitarese, Della Valle, & Moreira, 2002; Fuqua & Brosh, 2006; Walker & Ziskind, 1977). If not well controlled, nail biting can lead to serious morbidity, infections and serious traumatic lesions (Hodges et al., 1994).

2.2.1 Dental risks

There are cases where nail biting can lead to serious dental risks (Odenrick & Brattstrom, 1985). Common dental complications reportedly attributed to nail biting include malocclusion of the anterior teeth, and teeth root resorption due to non-physiological forces acting on the teeth (Odenrick & Brattstrom, 1985). For example, as front teeth are not designed for constant chewing, nail biting can cause irreversible damage to them. Teeth may become worn or chipped, or the enamel may crack. Long-term nail biting can also result in root resorption, or the shortening of the root. Nail biters who wear braces are especially susceptible to root resorption due to the already heightened pressure applied to the teeth. The result of this can be as serious as the shortening of the roots, which can result in teeth falling out and the need for implants or bridges to repair the damage (Odenrick & Brattstrom, 1985). A study in 1991 analysed possible factors influencing the prevalence of occlusal tooth wear in 90 young participants in a Saudi population. Its findings demonstrated that nail biting was one of the main factors that correlate significantly with increased occlusal tooth wear (Johansson, Fareed, & Omar, 1991). Similarly, a widely known case study was carried out in a Brazilian primary school where these injuries were directly related to the injuries sustained from nail biting

(Chevitarese et al., 2002). In investigating the prevalence of malocclusion in 112 Brazilian children from two primary schools, this clinical research indicated that nail biting was the decisive etiological factor of malocclusion (Chevitarese et al., 2002).

Chronic swollen gums due to nail biting habit have been reported (Hodges et al., 1994). Sharp edges of fingernails can cut or become embedded in the gums, which can cause a periodontal traumatic injury inducing serious complications. Open wounds of any nature, but especially those involving the mouth or fingernails, are more susceptible to infections that can enter the bloodstream. A case report of a 6-year old boy nail-biter was examined at the University of Nebraska Department of Paediatric Dentistry, USA. It was found that the child suffered from mucocele which required surgical removal, eruption gingivitis, and fifteen torn fingernail fragments were embedded in the gum causing damage to the periodontal tissues as the result of nail biting (Hodges et al., 1994). This case study highlighted the introduction of foreign bodies in association with habitual fingernail biting. “Foreign bodies in the soft tissues of the oral cavity have been reported previously, but this appears to be the first case of fingernail fragments embedded in the oral soft tissues” (Hodges et al., 1994, p. 237). Hideharu and Jenji (2003) also attributed the alveolar destruction in the area of the involved teeth to the forceful and continuous forces of nail biting.

Another more recent case report by Sousa et al. (2010) found similar problems. The researchers elaborated on an unusual case report of a gingival abscess due to a fingernail biting habit in a child, which was presumably associated with an emotional condition. Specifically, a 5-year, 6-month-old female was diagnosed with gingival swelling and fistula in the primary maxillary left central and right lateral incisors as an unusual sequelae to the periodontal tissues from fingernail biting. A periodontal treatment including a curette, and chlorhexidine solution was used along with psychological treatment because it was suspected that the deleterious habit was related to emotional tension and anxiety behaviours. After one month, nail biting habit still lingered, but the patient had stopped placing fragments into the gingival crevice and no more gingival inflammation or swelling was observed. It was suggested that fingernail biting could induce a periodontal traumatic injury yielding a more serious complication such as a gingival abscess. In the same vein,

according to a case report by Krejci (2000), habitual nail biting is one of the causes of gingival injuries as suggested by findings from a periodontal surgery. These findings confirm the belief of former researchers (such as Shetty and Munshi (1998) that gingivitis might result from excessive nail biting.

2.2.2 Injuries to nail and surrounding tissues

There are known cases where nail biting can lead to painful injuries of the finger nails (Chevitarese et al., 2002). The majority of people who suffered from acute paronychia (infection of the nail fold) reported nail biting. When nail biters are severely, persistently and frequently biting the nails, they are more prone to suffering acute paronychia, which involves painful inflammation, infection and awful pus formation of the tissues surrounding the nails. Treatment for acute paronychia usually requires painful surgical treatment (Fuqua & Brosh, 2006). In addition, severe nail biting has been reported to cause craniomandibular dysfunction (Westling, 1988). Salmon-Ehr and colleagues (1999) also reported a longitudinal case study on a 44-year-old woman who developed melanonychia (a common condition characterised by brown to black discolouration of the nail) induced by nail biting. In their review of injuries to the nail and surrounding tissues as a result of nail biting, Leonard et al. (1991, p. 281) listed “periungual warts, matrix damage resulting in scarring, pterygium, and damage to the nail bed with loss of the nail.” Severe nail biters are also reported to bite the cuticles and the skin of the fingers, leading to inflammation, widespread excoriation, and eventually keloids (Leonard et al., 1991).

2.2.3 Infections

Germs and worms are well documented as common health issues of nail biters, especially in most cases where hands and fingernails come into contact with untold numbers of germs each day (Tosti et al., 1994). A Polish study found that intestinal parasite infections were the most frequent among children, 11.0% of pre-schoolers and especially higher, 17.0%, among 7-year-old children (Kubiak et al., 2015). Nail biting can result in the transfer of germs such as cold and flu viruses, bacteria and

parasite eggs from the hands to the mouth. Ingesting germs and parasites can lead to serious illnesses (Creath et al., 1995) and the literature shows that gastrointestinal infections are more likely to develop in nail biters due to the transmission of diseases. Furthermore, a research study found that hygienic measures such as hand washing could reduce the spread of respiratory viral infections (Jefferson et al., 2001).

To assess the effect of a chronic nail biting habit on the oral carriage of *Enterobacteriaceae*, Baydas and colleagues (2007) studied microbiologically the saliva samples from 25 nail-biters and 34 non-nail-biters in India who were between the age of 11.5 and 15.1 years old. Their study revealed that the *Enterobacteriaceae* were more prevalent in the oral cavities of children with nail biting habits (76.0%) than in children without this habit (26.5%). This finding suggested that *E. coli* and total *Enterobacteriaceae* were more commonly found in the saliva of nail biting children than the ones without the habit (Baydas et al., 2007). This is also a possible explanation for cases reported of gingival swelling due to a fingernail biting habit.

With a similar interest, Reddy et al. (2014) investigated the likelihood of oral carriage of *Enterobacteriaceae* among a sample of 122 school children (11-15 years old) with chronic nail biting and 122 without this habit. Using microbiological examination of saliva samples, the study found statistically significant differences in the prevalence of *Enterobacteriaceae* between the two groups. Specifically, *Enterobacteriaceae* was detected in the saliva samples of 80 of the 122 nail-biters (65.5%) as opposed to only ten of the 122 subjects without nail biting. The result suggested a higher carriage of *Enterobacteriaceae* in the individuals having nail biting habits.

More recently, Kamal and Bernard (2015) carried out a study on a group of 8-15 years old to examine the oral carriage of *Enterobacteriaceae* in Indian children having the habit of nail biting and thumb sucking and to determine the association of the organism with the individual's respective plaque indices. Their findings suggested that nail biting showed a higher carriage of *Enterobacteria* species, predominantly *Escherichia coli.* This, together with similar previous research

findings, is evidence that nail biting may act as facilitator of the carriage of microorganisms into the oral cavity, which might lead to debilitating systemic conditions and intestinal parasitic infections (Escobedo, Cañete, & Núñez, 2008).

Osteomyelitis (bone infection) is another infection that has been reported in nail biters (Tosti et al., 1994; Waldman & Frieden, 1990) and may result in serious bone destruction or septicaemia (blood borne infection). It is caused by bacteria infection, commonly *Staphylococcus aureus.* The bacteria invade the bone via an external contaminated source such as an open wound and penetrating trauma (Potter, 2011). Biting nails down too far causes bleeding and open wound to the surrounding skin of the nails. Therefore, nail biters are more susceptible to osteomyelitis. A case report of a serious finger phalanx osteomyelitis was due to severe nail biting in a 39-year-old man. The laboratory evidence showed *Staphylococcus aureus* present in the tested sample (Tosti et al., 1994). Likewise, another case reported a similar problem of a child suffering osteomyelitis of a distal phalanx as a consequence of chronic nail biting (Waldman & Frieden, 1990). Furthermore, according to Saheeb (2005), nail biting could be associated with joint problems when approximately 25.0% of the patients with temporomandibular joint pain and dysfunction have been shown to suffer from this habit.

2.2.4 Social issues

In terms of social issues, nail biting can be associated with prosocial ability in children. In a study of a community sample of children from Shiraz, Iran, the parents of 743 primary school children were randomly selected. Children's prosocial ability was analysed by using the Strengths and Difficulties Questionnaire. The evidence indicated that nail biting children had less prosocial ability than their non- nail biting counterparts (Ghanizadeh, 2011).

Another possible social issue attributed to nail biting is social ostracism or social exclusion. Some researchers highlight social ostracism as a problematic side effect of fingernail biting because the nail biters may be teased by their peers with unattractive finger nails, and perceived by others as being insecure and stressed or

associated with additional negative attributions (Long, Miltenberger, Ellingson, & Ott, 1999).

Additionally, despite many documented cases about the consequences of nail biting, many parents of nail biting children still underestimated the problem. In a study of 60 children aged 4 - 15 years in Czechoslovakia with a history of nail biting, the survey results found that the parents of nail biting children rarely sought medical help. The authors concluded that perhaps the parents underestimated the importance of the underlying psychopathology problems (Bandova & Boor, 1974).

2.2.5 Co-occurring disorders

A very insightful question was raised about the aetiology of nail biting "Whether nail biting is only a bad habit or is it a symptom of some underlying psychological problem" (Cannon, 1986, p. 151). However, currently available clinical findings are not conclusive on this matter. Earlier, a controlled study by Veits (1931) investigated the significance of nail biting in children and adolescents. The study found no significant relationship between nail biting and nervousness, or intelligence or physical condition, nor was it associated with any one pattern of problem behaviour (Veits, 1931).

On the contrary, another research by Billig (1941) depicted nail biting as more than just a bad habit when investigating the extent to which nail biting was related to intelligence, neuroticism, fear, and sense of guilt among 10th grade children. After a period of 8 years, the research results showed that nail-biters had slightly lower IQs than non-nail-biters and they were somewhat more neurotic (Billig, 1941). The findings of this study present a need for future studies to examine if nail biters are more neurotic and have lower IQs than non-nail-biters or whether have neurotic behaviour or a low IQ predisposes one to nail biting.

The findings of another experiment by Ghanizadeh (2008) were in accord with previous findings that associate nail biting with psychological problems. His research study investigated the possible connection between nail biting and psychiatric disorders in children and their parents in a psychiatrically referred sample of 63

children with nail biting at the Child and Adolescent Psychiatry Clinic of Shiraz University of Medical Sciences, Fars, Iran. The results showed that nail biting was a common disorder amongst children and adolescents in the mental health clinic, which indicated an association between nail biting and many psychiatric disorders. Ghanizadeh (2008) also found that nail biters suffered one or more psychiatric disorders (Ghanizadeh, 2008). The most common co-morbid disorder is attention deficit hyperactivity disorder (ADHD) (74.6%), followed by oppositional defiant disorder (36.0%) and anxiety disorder (20.6 %). Other less common disorders were Enuresis (bed wetting) (15.6 %), Tic disorder (12.7 %), Obsessive compulsive disorder (11.1%); Mental retardation (9.5%); and Tourette syndrome. It was also found that nail biting presented in a significant proportion of referrals to a mental healthcare clinic setting.

The tendency of nail biting to be associated with other co-morbid disorders, such as higher obsessive-compulsive behaviours, has been supported by other researchers (Joubert, 1993; Pacan, Grzesiak, Reich, & Szepietowski, 2009). Furthermore, nail biting is found to be a co-morbid problem in some psychiatric disorders such as tic disorder, as reported by Ghanizadeh and Mosallaei (2009). In a more recent study on 743 primary school children in India, selected by random sampling, Ghanizadeh and Shekoohi (2011) also found that emotional and behavioural problems are more common in children with nail biting than those without nail biting.

The potential role of sleep physiology and disturbances such as obstructive sleep apnea (OSA) in the pathogenesis of impulse-control disorders such as nail biting (onychophagia) is currently suggested by Nino and Singareddy (2013). The researchers reported a case study on a male patient whose severe onychophagia and biting-induced finger mutilation was completely resolved after diagnosis and treatment of severe OSA. They proposed a relationship between sleep and the neurobiological circuits that regulate nail biting habit and similar impulse control behaviours exists.

Another study conducted by Levine (1943) investigated nail biting in 150 American naval recruits with enuresis problems. He found that severe nail biting was often

present in the subjects with enuresis. The findings of this study were in accord with Ghanizadeh's results in that nail biting is associated with enuresis (Levine, 1943).

Many scholars, health professionals and the public still have the perception that nail biting is a relatively benign problem (Woods et al., 2001). However, with the evidence on the relationships between nail biting and socio-psychological and psychiatric disorders above, and many documented reports about serious health problems associated with nail biting, should they still really think nail biting is a relatively benign problem? Ghanizadeh (2008) suggested the importance of awareness of co-occurring symptoms that may be associated with nail biting and lead to a better knowledge about nail biting and thereby the development of new better approaches in treatment and prevention of nail biting. Another study reported that about 25.0% of young people in South Africa with depression also suffer nail biting problem (Calitz, Veitch, & Verkhovsky, 2007).

2.3 Possible causes of nail biting

The causes of nail biting have been examined on the basis of observation, speculation and part of mythology (Clark, 1970). However, the basic cause of nail biting is hard to determine (Sachan & Chaturvedi, 2012). Currently, no single theory satisfactorily explains the underlying causes of nail biting, nor is there any specific diagnostic category for nail biting as remarked in Merck manual, 19th edition (Potter, 2011). As remarked by Dufrene et al. (2008) "Theory and research describing etiology of nail biting offers varying and sometimes conflicting explanations" (p.913). Several theoretical considerations have been proposed. These include oral fixation, obsessive-compulsive disorders, psychological and psychiatric issues, genetic causes, and mineral imbalances.

2.3.1 Aetiology 1: Oral fixation

In 1915, the leading psychologist Sigmund Freud believed that nail biting is an oral fixation, a craving desire to put things in the mouth as a form of stimulation and pleasure (Frost, Mukkamala, & Covington, 2008). He explained that nail biting may be related to a psychosexual stage, part of the oral stage of development. Freud

then identified four psychosexual development stages of a child: the oral, anal, phallic and genital stages. At each development stage, a different part of the body becomes a child's favourite area, which is capable of producing pleasure, and it is the primary source of sexual arousal.

The oral stage is believed by Freud to occur during the first year of life at which most of the infant's pleasures comes from the mouth. He postulated that oral fixation (such as nail biting) might be created if a child was insufficiently fed, forcefully fed, overfed or frustrated. Similarly, according to Coon (2004), the child will be fixated in the present stage when the child's emotional issues and conflicts are unresolved. However, this theory cannot explain the cases where nail biting start at an older age than one year old.

2.3.2 Aetiology 2: Obsessive-compulsive disorder (OCD)

In another aetiological hypothesis, nail biting or onychophagia was widely identified as a compulsive behaviour (Ravindran, Silva, Ravindran, Richter, & Rector, 2009). To investigate this hypothesis, several researchers used cognitive-behavioural therapies to treat nail biting to break compulsive behaviour. Several forms of behavioural therapy have been investigated, such as habit reversal therapy (Ghanizadeh, 2011). However, while nail biting has similar treatments and characteristics to those of OCD, nail biting has rarely been formally regarded as OCD in medical literature (Hodges et al., 1994). Furthermore, studies supporting the OCD hypothesis have not demonstrated impressive results.

2.3.3 Aetiology 3: Psychological and psychiatric causes

Many researchers have pointed to psychological and psychiatric issues in an effort to explain for the habitual disorder of nail biting. In other words, it is suggested that nail biting might be reflective of underlying psychopathology (Dufrene et al., 2008).

The etiological factors for nail biting reported in a body of research are anxiety, stress, tension, loneliness, and inactivity (Tanaka et al., 2008). Situations that trigger fear, boredom, or pain are also associated with fingernail biting (Doctor, 2000).

Since the early researches into nail biting, this habitual disorder has been considered a reflex of emotional imbalances with documented demonstration of anxiety and tense moments (Deardoff et al., 1974). These common explanations have been strongly supported by later researchers, such as Foster (1998) and Wood et al. (2001). In addition, nail biting is widely believed to be a stress-relieving oral habit in both children and young adults (Sachan & Chaturvedi, 2012).

The causative agent in fingernail biting is often thought to be anxiety. The relationship of nail biting and anxiety was reported in a study on primary sociopaths by Walker and Ziskind (1977) using the Cornell Medical Index Health Questionnaire. The results indicated that the incidence of nail biting in primary sociopaths (48.0%) was significantly greater (p less than .01) than the incidence of nail biting in the control group (24.0%). Some researchers have also suggested an association between nail biting and anxiety, with evidence on the positive correlations between nail biting and the Taylor Manifest Anxiety Scale (Klatte & Deardorff, 1981).

In a study in 1988, interviews were conducted with 24 teachers, and 32 parents about children who had nail biting, thumb sucking and motor stereotyped behaviours (Foster, 1998). It was concluded that nail biting behaviour appears to be a reflection of mood, such as nervousness (Foster, 1998). Another study using questionnaire survey found similar results (Coleman & McCalley, 1925). The research participants were college students, including 54 present biters and 54 who had never bitten nails. All subjects were given the Bernreuter Inventory and a personal data sheet concerning childhood security feelings. The results demonstrated that nail-biters rated significantly more introverted and neurotic on the Bernreuter Inventory and more current anxiety than non-nail-biters (Coleman & McCalley, 1925). Another study investigated nail biting and manifest anxiety in ten adult nail-biters and ten non-nail-biters (Klatte & Deardorff, 1981). According to a case report based on self-monitoring recordings by Mcclanahan (1995), anxiety was the most prevalent antecedent of nail biting. The results of these research studies are in accord with previous findings that nail-biters were more anxious than non-nail-biters.

The hypothesis that attributes nail biting to anxiety or nervousness was supported by the frequent association between anxiety and nail biting. However, this theory can be challenged by other findings that nail-biters do bite their nails in situations of both inactivity and anxiety (Hansen, Tishelman, Hawkins, & Doepke, 1990). The challenge against this theory was raised by researchers who proposed the arousal modulation theory which suggested that the function of nail biting was to calm them down in times of autonomic arousal (stress or anxiety) and to provide stimulation (alert or stay awake) during periods of boredom or inactivity (Hansen et al., 1990). Other researchers' findings were consistent with the "arousal-modulation theory." For example, in a 2007 study, the frequency of nail biting in 40 undergraduate nail biters at the University Psychology Department, United Kingdom were recorded in four settings: being left alone (boredom), solving maths problems (frustration, anxiety), being reprimanded for nail biting (contingent attention), and continuous conversation (non-contingent attention). The results proved that nail biting was evoked as a result of boredom and frustration or working on difficult tasks (Williams, Rose, & Chisholm, 2007). Therefore, it may be concluded that nail biting could be caused by other psychological states apart from "anxiety" or "nervousness" (Woods et al., 2001).

Other researchers found similar findings with Woods' results (Deardoff et al., 1974). A study investigated the association between nail biting and manifest anxiety in children. The results indicated insignificant different manifest anxiety between nail-biters and non-nail-biters (Deardoff, et al., 1974). The findings of these studies in this context seemed to be more convincing. However, their research did not deal with and contribute much to the primary underlying cause of nail biting.

An interesting author postulates a paradoxical anxiety effect that nail biting is a sign of inhibited hostility or personal disarmament hence the nail biter may become nervous or anxious, as a consequence of nail biting (Ellerbroek, 1978). To date, no experiments had been done to test this hypothesis. This hypothesis seemed to be weak because many nail-biters did not experience anxiety while nail biting as demonstrated in the above studies. It is still inconclusive as to whether anxiety leads to nail biting or it may only be a co-occurring symptom with nail biting.

Other psychological issues are also reported by later researchers. For example, Michopoulos and his colleague (2012) reported on a case of a 66-year old man with severe finger mutilation as a result of serious nail biting for 6 years. His self-mutilating behaviour was associated with severe diabetic neuropathy, impulsivity, and social isolation. Williams et al. (2007) carried out an intervention on 40 undergraduate student nail biters, using randomised allocation to four conditions of being left alone (boredom), solving maths problems (frustration), being reprimanded for nail biting (contingent attention), and continuous conversation (noncontingent attention). Their findings revealed the most frequent occurrences of nail biting in the two conditions of boredom and frustration. This is evidence for the link between nail biting and particular emotional states.

2.3.4 Aetiology 4: Genetic causes

Another etiologic perspective of nail biting is the contribution of genetic factor. Evidence of a study on nail biting in twins showed a strong association between genetics and nail biting (Bakwin, 1971). Another study on Japanese twins using questionnaires also supported the above findings (Ooki, 2005). To determine the genetic contribution to nail biting among children, Ooki (2005) conducted a large scale study, involving a total of 1,131 pairs of 12-year-old twin children in Japan. Findings from maternal questionnaires and medical interviews indicated that nail biting was prevalent among 28.0% of the males and 26.0% of the females. Univariate and bivariate genetic analyses showed that the proportion of total phenotypic variance attributable to genetic influences was 50.0% in both males and females for nail biting. From a similar genetic perspective, Ghanizadeh (2008) found that more than half of the mothers and nearly half of the fathers of a clinical sample of children with nail biting had at least one psychiatric disorder.

2.3.5 Aetiology 5: Mineral theory

Researchers with an interest in the aetiological study of nail biting have also investigated the relationship between this habitual disorder and mineral imbalances. This discussion deals with the mineral theories and how they may be

related to the cause of nail biting (Diamond, 2011). Such theories define the effects of minerals and why mineral deficiency or imbalance in the body may cause nail biting in the first place. The results presented in this section emphasise the findings from Dr Schuessler and his theory that 12 principal mineral compounds are essential for our health (Diamond, 2011; Schuessler & Collin, 1984). Accompanying this theory, a condition called Pica is reviewed (Gutelius, Millican, Layman, Cohen, & Dublin, 1962). A list of possible aetiologies associated with Pica is also closely reviewed, especially with the mineral deficiency aetiology in pica which might be linked with the cause of nail biting.

Despite the obvious prevalence of nail biting problem, the aetiology of childhood nail biting behaviour remains relatively poorly understood, with most research focussing upon the psychological perspective: the relationships between nail biting and anxiety, stress or nervousness. Similarly to nail biting, most previous research in childhood behaviour and psychiatric disorder was mainly focussing upon psychological perspective: the relationships between psychiatric health outcomes and parental characteristics, socio-economic status and stresses (LeClair & Quig, 2001). However, recently, an increasing body of research has been looking at a different perspective by studying the mineral effects on children's behavioural and psychiatric disorders (LeClair & Quig, 2001). It has been speculated for years that mineral deficiency causes individuals to engage in nail biting behaviour to ameliorate their mineral status (Kingsley, Kenyon, Mrrow-Brown, & Thomas, 2005; Whitcroft, 2009). The relationship between nail biting and mineral deficiencies has only been mentioned in alternative or complementary medicines (Jones, 2011; Kingsley et al., 2005; Odey, 2011) and lacks scientific research evidence. Strikingly, the mineral component of nails is found to be similar to that of bone content, comprising dominantly calcium, magnesium, potassium, zinc, iron and sodium (Ohgitani, Fujita, & Nishio, 2005; Whitcroft, 2009). In most cases, nail biting may indicate calcium, magnesium, other minerals and zinc deficiency (Atlantapostpolio, 2012).

Nail disorders such as brittle nails are often encountered in people with osteoporosis, disorders of calcium metabolism such as malabsorption,

hyperparathyroidism or hyperparathyroidism. Thus, abnormal metabolism possibly reflects abnormal nail mineral content (Atlantapostpolio, 2012). Our foods are often lacking in these minerals (Thomas, 2012). All of these findings suggest that nail biting could be a manifestation of deficiency in one or more combinations of bone minerals. It is hypothesised that the body unconsciously attempts to replenish those deficiency minerals through nail biting (Odey, 2011). Consequently, the repetitive nail biting action creates a reward cycle in the brain and establishes a stubborn habit (Jones, 2011) or in severe cases, becomes a compulsive disorder (Tanaka et al., 2008). It is suggested that taking the appropriate minerals (perhaps similar to the bone mineral content) might break the nail biting habit.

Multiple research studies have found that zinc deficiency is very common at all ages (Pennington & Schoen, 1996; Sandstead, 1991). Zinc has broad effects on DNA and growth, as it is essential for the production and function of RNA and DNA. These two genetic substances, RNA and DNA, are involved in all cellular growth (Prasad, 1983). Therefore, zinc is very important for children health and development. Children and teenagers experience rapid growth, hence, have a great requirement for zinc. After considering the widespread deficiency in zinc and rapid growth in children, it is suggested that additional zinc supplement in children is beneficial to avoid the deficiency (Ethical-Nutrients, 2010). Furthermore, a zinc deficiency may cause a growth impairment, as RNA and DNA control growth of the human body (Prasad, 1983). It is suggested that children with below normal height or weight measures may be zinc deficient (Ethical-Nutrients, 2010). Possible signs that could indicate zinc deficiency in children are white spots on finger nails, nail biting (Atlantapostpolio, 2012), dental cavities, reduced body size, skin rashes or allergies (Pfeiffer & Jenney, 1974).

Exploring the cause of nail biting in terms of the mineral theory is significant because minerals are essential for human active life-giving processes such as body chemical reactions and particularly physiological healings (Chapman, 1996). It may hold a key to explain the root cause of nail biting. Historically, looking at the earlier contents relating to minerals, our life processes are carried on by sophisticated chemical reactions in the body that all tie back to minerals (Diamond, 2011).

In the 19th century, one of the foremost, great scientists, Rudolph Virchow (cellular pathology), discovered the foundation of Biochemistry. According to Virchow (Diamond, 2011; Prasad, 1983), the human body is known to be composed of an abundant amount of tiny cells and each cell is composed of an infinitesimal and perfectly balanced quantity of three groups of elements: organic, inorganic (minerals) and water. Even though the organic and water are present in much greater portion of living cells, the inorganic (minerals) is really the essential elements of the body, especially with physiological healing process. The mineral is the only substance that the cells cannot produce by themselves. The water and the organic substances are inert and useless in the absence of the vital cell-minerals (Chapman, 1996). Since the life of living cells is relatively short, the reproduction of new cells depends greatly on the presence of cell-minerals. If the functioning minerals are deficient or imbalanced in the body, this rebuilding process and cell reaction are slowed down (Diamond, 2011; Prasad, 1983). The results of this can lead to diseases, illnesses, or physical symptoms in many forms. Nail biting may be one of the most common forms (Jacka, 2008).

Dr Schuessler's work mentioned in a number of studies (Diamond, 2011; Rieger, 2010; Schuessler & Collin, 1984), supported the above theory through his discoveries of the 12 principal mineral compounds that are essential for our health. His observations and findings suggested that while there were many other factors involved in the cause of diseases, the functional disturbances caused by mineral compounds imbalance was classed as one of the most common factors. Schuessler's theory indicated that any disturbance in absorption, assimilation or metabolism process of the 12 principal minerals compounds could eventually lead to deficiency or relative imbalance within cells. The effects of these imbalances consequently may lead to symptoms, disorders, illnesses or diseases including symptoms relating to food aversions (Chapman, 1996; Jacka, 2008), gouty conditions, cough, cold smelly sweaty feet, falling hair, osteoarthritis, skin disorders and many other physiological symptoms (Diamond, 2011; Silber & Haynes, 1992).

Furthermore, another medical doctor, Dr Hungerford, suggested a similar concept with Dr Schuessler that micronutrient (such as minerals) deficiency was a great

concern for modern illnesses: “Most people in the Western world generally get enough calories and protein to sustain health. Most of their deficiency problems, however, are the result of micronutrient deficiencies. These deficiencies are common and usually unrecognised. Also, they rarely occur in isolation: a diet producing one deficiency is likely to produce multiple deficiencies.” (Hungerford, 2008, p. 201). Therefore, the lack of one or more of these 12 principal minerals may also be linked to the root cause of nail biting.

Other findings by Dr Schuessler (Rieger, 2010; Schuessler & Collin, 1984) emphasise the ability to absorb minerals efficiently into our body and into cellular level. He noted that, even with a well-balanced diet, rich in minerals, trace elements and vitamins, our body sometimes still failed to assimilate these elements into the blood, the tissues and especially into cells. In crude form (as in foods), minerals are found as tightly packed concentrates; unfortunately, this is not easily absorbed into the body. The supporting theory behind this is related to the molecular imbalance of certain mineral salts that may be impeding the assimilation and nutritional process (Diamond, 2011; Schuessler & Collin, 1984). The minerals contained in the food (are found as tightly-packed concentrates) will rely on our body digestive processes to break it down into assimilable factors. If the digestive processes are weak, nutritional biochemistry is quite difficult. In such circumstances, by administering the mineral compounds in their readily assimilable form, the body would be able to restore the physiological intracellular equilibrium that prevents the normal nutritional process (Jacka, 2008). Therefore, Dr Schuessler concluded that a prerequisite for optimal health is the ability to uptake nutrients into the cellular level together with a proper utilisation of nutrients (assimilation process) which is the key factor to nutritional biochemistry (Diamond, 2011; Rieger, 2010).

Dr Schuessler Tissue salts (STC) therapy addresses the imbalance/deficiency of minerals on a cellular level. The purpose of STC therapy is not to supply the body with the deficiency minerals but rather aims to accelerate, stimulate and improve absorption of the lacking minerals from ingested food/supplements inside the cells and ensuring proper utilisation (Chapman, 1996). He pointed out that a requirement for optimal health was the ability to uptake and proper metabolise

nutrients on the cellular level (Diamond, 2011). Furthermore, he found that if the minerals were in a macro form (undiluted or untriturated), they would not be able to penetrate into the cells readily and easily. In addition, they would strain the body and cause no unwanted side effects. Importantly, it is a homeopathic dose which is found to be almost similar to the concentration of cellular mineral content (Rieger, 2010). Therefore, he found the most effective method to assimilate these deficient minerals intracellular was through a homeopathically prepared micro-dose (diluted and triturated, which is found almost similar to the intracellular concentration), which absorbed rapidly in the blood stream and therefore into cells (Jacka, 2008; Rieger, 2010). "The tissue salt in its potentised state is able to "bridge the gap" and restore the molecular imbalance that may be impeding the nutritional process. Assimilation can then proceed in a normal manner, and the body should be able to obtain all the nutrients its needs from the foods eaten" (Jacka, 2008, p. 5). Mineral salts are harmless, as they are cell food or cell-minerals which naturally occur in the body. They cause no known side-effects. They cannot become toxic in the body due to overdose as they merely replace what is deficient, in microscopic dose and also the body eliminates any excess (Chapman, 1996). According to Dr Schussler's theory, most illnesses are based on a disturbance of the mineral imbalance in the body; hence, one can postulate the association of nail biting and tissue-mineral deficiency.

An international proponent of Schuessler Tissure Salts, Gianevsky (2012), who has many years' experiences successfully treating patients with Schuessler Tissue Salts, commented that while the tissue-minerals could restore the intracellular mineral balance, thus, alleviating the symptoms; but if the root cause of the disturbed metabolism was not directly eliminated, then the disease could return shortly thereafter. In other words, the tissue salts may impact on nervous illness by allowing restored tissue equilibrium to enable an individual to correct emotional imbalances. This is the reason why Biochemistry or Schuessler Tissue Salts may not help in all (non-surgical) conditions. For example, if the root cause of an illness is an emotional disturbance (such as stress or anxiety) that lead to cell-mineral deficiency, the Schuessler tissue salts may quickly restore intracellular equilibrium

and will definitely ameliorate the overall strength of the patient, thus, giving the patient a much better chance of overcoming the emotional disturbance. However, supplement of Schuessler tissue salts does not automatically guarantee that the emotional problems themselves (root cause) will be overcome. Moreover, it is unlikely that any supplement of the tissue minerals would increase the severity of the illness. Low concentration in the Tissue Salts preparation seems unlikely to significantly cause harm to any person taking the Tissue Salts, but it is very probable that an illness will ameliorate. This is the reason why tissue-minerals are greatly useful in *Acute* and *Short Term* illness but for the long term effective treatment of a chronic disease is not guaranteed by use of the tissue salts alone (Gianevsky, 2012). By applying the above suggestions and mineral theories, a combination of Schuessler Tissue Salts (for acceleration of absorption and utilisation of other supplements hence immediate alleviating of nail biting) together with mega dose of other mineral supplements for long term effective treatment of nail biting, maybe useful in treatment of nail biting (Diamond, 2011).

Based on similar concepts with Dr Schuessler's Tissue Salts theory, an Australian naturopath, Maurice Blackmore in 1938, pioneered Celloid minerals therapy that helped rebalance physiological mineral deficiencies. Blackmore formulated these minerals in physiological active doses in milligrams, a larger dose compared with homeopathically micro-dose as in Dr Schuessler's Tissue Salts therapy. These Celloid minerals are not only potentised like homeopathic preparations, but also deliver a gross dose of minerals effectively into the living cells and tissue (Rolfe, 2012).

2.3.5.1 Magnesium

Magnesium is essential for over three hundreds of biochemical reactions and yet magnesium deficiency is found consistently in most people. The busier the person is the more magnesium is required to maintain a good health (Durlach, 1993). There are factors influencing magnesium absorption. Dietary phytate, fibre, calcium, unabsorbed fatty acids present in high quantities, may bind to magnesium to form a big complex molecule and make it less available for absorption. Vitamin D increases magnesium absorption (Gropper, Smith, & Groff, 2000). Recent study have shown a

high level (30.0%) of mild vitamin D deficiency in Australians (Daly et al., 2012). Therefore, the association between magnesium and Vitamin D, magnesium deficiency might exist.

Approximately 60.0% of magnesium in the body is found in the bone (Gropper et al., 2000; Shils, Olson, & Shike, 1994). The rest of magnesium is found in extracellular fluids, soft tissues (primarily muscle), within cells as part of cell membranes. Magnesium is fundamental for membrane stabilisation. It is involved with nucleic acids, enzymes and ATP to stabilise the structure. Magnesium plays many critical and fundamental roles in the body such as: nerve impulse transmission, homeostasis of calcium, glycolysis, Krebs cycle, nucleic acid synthesis, DNA and RNA transcription-synthesis-degeneration, cardiac and smooth muscle contractability, protein synthesis, formation of cyclic adenosine monophosphate (CAMP). Magnesium has an interrelationship with many minerals, particularly calcium, sodium and potassium. It regulates intracellular calcium, sodium and potassium (Shils et al., 1994).

Deficiency of magnesium may be associated with depression, muscle weakness, behaviour disturbances, convulsions and growth failure (Dean, 2007). Osiecki agreed and added some extra suggestions that deficiency of magnesium could cause or to be associated with: anxiety, agitation, anaemia (haemolytic), insomnia, IQ loss, irritability, neurotic behaviour, osteoporosis and poor appetite (Osiecki, 2010). As mentioned before, one study found frequent eating disorders with nail biters (Cavaggioni & Romano, 2003), and that magnesium may cause poor appetite. Theoretically, this may provide a link between nail biting and magnesium deficiency.

Since magnesium has a highly interactive relationship with calcium (Shils et al., 1994); and imbalance between magnesium and calcium has critical biochemical implications, it is difficult to discuss magnesium without understanding the function of calcium in the body.

Magnesium deficiency is not caused by absolute magnesium deficiency alone but may result from imbalance relative to calcium. Consumption of dairy-based diet rich in calcium but without equal amounts of magnesium (as in western diet), can lead

to magnesium deficiency. According to Hungerford (2008), many of the illnesses associated with magnesium deficiency are diseases of dairy cultures, which indicates the link between nail biting children and milk consumption as one of the primary sources of children's diet with a possible magnesium deficiency.

Magnesium and potassium have a strong interrelationship with each other in the body. Deficit in magnesium can in turn induce potassium deficient. Treatment for tissue potassium deficiency is often refractory when tissue magnesium is inadequate. This is because the amount of tissue magnesium controls the amount of tissue potassium. Magnesium is vital for the sodium/ potassium pump. Magnesium assist cells to pump sodium out and influx potassium into cell. As a chain reaction, deficit of magnesium can lead to tissue potassium deficiency. Therefore, to correct potassium-deficient, one must correct magnesium level first (Martin & Milligan, 1987).

Calcium supplements are often recommended to prevent osteoporosis. Calcium supplement without magnesium supplement can further increase risk of magnesium deficiency due to alteration in the ratio of calcium to magnesium (Dean, 2007). As magnesium has been mentioned in the discussion of nail biting, it is appropriate to include magnesium discussion in this chapter. Some studies in the past 30 years suggested an association between sudden death and magnesium deficiency (Eisenberg, 1992; Spasov, Iezhitsa, Kharitonova, & Gurova, 2008; Tzivani et al., 1988).

Magnesium engages in many importance roles in the nervous system. Therefore, magnesium deficiency may manifests of many psychological symptoms such as anxiety, depression, eyes twitches, poor memory, apathy, apprehension, poor memory, confusion, anger, nervousness, a tingling/pricking/creeping feeling on the skin, and insomnia (Dean, 2007; Durlach, 1993). Magnesium influences the production and function of serotonin which is a "happy" brain chemical. The body uses magnesium to bind and release serotonin in the brain for maintaining healthy mental function. A deficit of magnesium cause stress and also stress itself cause magnesium depletion. As a result of long-term stress, a vicious cycle of magnesium

depletion occurs and consequently can lead to chronic anxiety and depression (Durlach, 1993). Rogers (1997) suggested that magnesium is a potential underlying cause for all types of depression.

A striking research was conducted in 500 depressed subjects by Dr Cox and Shealy (1996). The results showed that most depression sufferers were magnesium deficient. The findings of this study indicated that magnesium deficiency could be the root cause of anxiety and depression. The researchers of this study suggested clinicians consider magnesium therapy in treating chronic depression (Cox et al., 1996).

2.3.5.2 Calcium

Calcium is the most abundant mineral in the body (Osiecki, 2010). It is the fundamental structural component of bones and teeth (Hungerford, 2008). It is critically involved in many processes in the body, including cell membrane permeability, the maintenance of electrolyte balance within cells, muscle contraction, nerve transmission, regulation of cell division and modifying effects on hormone balances, regulate PH balance, enzyme activation and blood clotting. Foods that bind calcium and hence decrease absorption of calcium are: rhubarb, spinach, chard, cereal and grains rich in phytic acid. Factors increasing demand of calcium include: depression, stress, high sodium intake, high phosphate intake, high protein and sugar diets, intestinal malabsorption and magnesium deficiency. Excessive intakes of zinc, magnesium, iron, sodium and manganese also increase calcium demand in the body. Deficiency of calcium may cause or be associated with agitation, anxiety, osteoporosis, hyperactivity, hyperirritability, cognitive impairment, brittle finger nails, ADHD (Osiecki, 2010).

2.3.5.3 Silica

Evidence over the last 30 years strongly suggests that dietary silica is beneficial to bone and connective tissue health and strong positive associations have been reported between dietary Silica intake and bone mineral density in US and UK cohorts (Jugdaohsingh, 2007). Silica is a major (naturally occurring) trace element in

the human body derived predominantly from the diet (Jugdaohsingh, 2007). Silicon deprivation experiments in the 1970s, in growing chicks (Carlisle, 1972) and rats (Schwarz & Milne, 1972), suggested that silica may also be essential for normal growth and development in higher animals, including humans, primarily in the formation of bone and connective tissues.

Silica appears to have a beneficial role in bone formation and in bone health. Since the findings of Carlisle (1972) and Schwarz and Milne (1972) of a potential role of silica in bone and connective tissues, there have been numerous studies over the past 30 years investigating this potential role of dietary silica. Studies evidence that in osteoporotic subjects silica supplementation with monomethyl trisilanol resulted in increased bone volume (Schiano et al., 1979) and increases in femoral and lumbar spine BMD (Eisinger & Clairet, 1993). In the latter study, silica was shown to be more effective than Etidronate (a bisphosphonate) and sodium fluoride. More recent studies using silica (in the form of orthosilicic acid) have also reported increases in type I collagen synthesis and cellular differentiation (Reffitt, Ogston, & Jugdaohsingh, 2003) and in addition increases in the mRNA of these proteins, suggesting potential involvement of Silica in gene transcription (Arumugam, Ireland, Brooks, Rushton, & Bonfield, 2006; Reffitt et al., 2003). Silica is an essential mineral in Keratin synthesis in nails (Holizen, 2016).

Mechanisms are unclear but evidence exists of its involvement in collagen synthesis and/or its stabilisation and in matrix mineralisation (or mechanisms are not clear but it has been suggested, based on the evidence above, that silicon is involved in bone formation through the synthesis and/or stabilisation of collagen). Collagen is the most abundant protein in bone matrix conferring flexibility and, with elastin, is a major component of connective tissues which is found in skin, cartilage, tendons and arteries (Jugdaohsingh, 2007).

2.3.5.4 Zinc

Zinc deficiency may be caused by mal-absorptive diseases (enteritis, celiac, cystic fibrosis), or diets low in zinc. Findings also suggest that premature and low birth weight babies have a higher risks of zinc deficiency (Barbarot et al., 2010).

Clinical symptoms associated with zinc deficiency:

- Mild Zinc deficiency includes weak immunity, poor appetite, impaired growth;
- Moderate to severe Zinc deficiency includes abrupt mood change, irritability, lethargy, impaired immune function, skin rash, diarrhoea, alopecia (Prasad, 2013).

It is very likely that many health professionals may have some reservation on the view mentioned above in terms of research evidence.

2.3.5.5 Causes of mineral imbalances

There are contributing factors to mineral imbalances, including stress, diet and poor nutrition (Hungerford, 2008).

During stress, either physical or emotional (such as parents' separation), the body increases secretion of hormones and increases adrenal activity (Hungerford, 2008; Larzelere & Jones, 2008). As a result, the body's demand for minerals increases. Consequently, if chronic stress is not controlled, it can lead to mineral imbalances. Certain minerals such as zinc, calcium, magnesium, potassium are found to be lost in greater quantities due to increased stress (Interclinical-Laboratories, 2009).

Why is nail biting very often associated with stressful situations? During time of stress, the body produces excessive acids (Larzelere & Jones, 2008), which can be toxic to the body. It is suggested that the body tries to neutralise the excess acids with the extra alkali minerals (calcium, magnesium, potassium) in nails at times of stress (Whitcroft, 2009).

The most common factor causing poor mineral nutrition is poor eating habits, fussy eating or poor food choices (Groff, 2000). Excessive intake of refined carbohydrates, alcohol and fad diets can impair mineral absorption and lead to mineral imbalances. Even so, eating a 'healthy diet' does still not guarantee adequate minerals because the mineral content in food is dependent on the mineral content of the soil in which

the food was grown and the cooking method by which it was prepared (Hungerford, 2008).

Interestingly, poor eating habits such as fussy eating are found very common in children (Chatoor, 2009), so is nail biting. This observation has led to the suggestion that there is a potential relationship between nail biting and mineral deficiency in children. An Australian study in Brisbane found that about 28.0% of mothers reported their 2 - 4 years old children were sometimes or often an irregular eater; and these irregular eating children were often have insomnia and behavioural problems such as anxiety-depressive symptoms (McDermott et al., 2008). Another American study also found around 20.0% of children are fussy eaters (Mascola, Bryson, & Agras, 2010).

Dr Ashmead, stated in his book *Chelated Mineral Nutrition in Plants, Animals and Man*, "There are at least eighteen barriers to mineral absorption, which means that the minerals we consume do not necessarily wind up in our bodies." (cited in Interclinical-laboratories (2009, p. 7)). According to Dr Ashmead, Cellular metabolism is regulated by neurological and endocrine functions which will affect nutrient absorption, retention and excretion. Vitamins and mineral can interact with each other to exhibit antagonistic effects. They may interfere with or reduce the bioavailability of other nutrients. They also may enhance absorption and utilisation of other minerals (Ethical-Nutirents, 2011). A randomised controlled study investigated the ability of probiotic supplement for prevention of antibiotic-associated diarrhoea in 80 infants. The results showed a significant reduction in the occurrence of diarrhoea in infants supplemented with probiotic formula compared with the control group (Correa, Peret-Filho, Penna, Lima, & Nicoli, 2005).

To support the mineral theory of Dr Schuessler and the scientist Rudolph Virchov, many researchers have confirmed the association of Pica with mineral imbalances, especially iron deficiency anaemia (Telford, 1822). Pica is a compulsive craving disorder of eating non-edible substances. Upon this definition, should nail biting be classified in a spectrum of pica disorder? Nails are nonedible substance; nail biters have uncontrollable craving urge to bite their nails, nail fragments had been found

in the stomach and embedded in the nail biter's gum. To date, no research has studied nail biting as pica disorder; or the association of nail biting and iron deficiency anaemia; or other minerals deficiency as in pica researches.

The basis for staying fit and healthy is to ensure that the body has adequate daily vital vitamins and minerals. However, poor dietary choices and widespread soil and crop depletion of minerals and nutrients may put people in modern westernised societies at high risk of developing nutritional deficiencies. A recent landmark study by the Harvard school of Public health has indicated that there is widespread suboptimal nutritional intake of vitamins and minerals in Westernised societies (Fairfield & Fletcher, 2002). This is discussed in more detail in the *NHMRC's Dietary Guidelines for Australian Adults* which, together with the *Dietary Guidelines for Children and Adolescents in Australia*, the *Dietary Guidelines for Older Australians and the New Zealand Food and Nutrition Guidelines* for the ages and stages of the lifecycle (NHMRC, 2006). Therefore, supplementation may be required to ensure optimal nutritional requirements for general wellness and the prevention of illness.

Malnutrition cases are not solely found in developing countries but are also common among children in the industrialised nations with varying degree of malnutrition. In many cases, only the severe nutritional disorders are easily identified due to the obvious signs and symptoms, however with the milder malnutrition cases, it is less conspicuous. These are usually due to a combination of nutrient deficiencies that have nonspecific symptoms. Clues to nutritional deficiencies can be identified by physical examinations. However further tests are needed to identify specific nutrient(s). These include the assessment of the subject diet history, laboratory findings and associated symptoms (Balint, 1998).

A striking study on "the significant magnesium deficiency in depression" was conducted in 500 depressed subjects by Drs Cox and Shealy (1996). This study showed that almost all depression sufferers were magnesium deficient. The findings of this study indicated that magnesium deficiency can be the root cause of anxiety and depression. The researchers of this study suggested clinicians to consider magnesium therapy in treating chronic depression (Cox et al., 1996). Magnesium

deficiency could be a plausible link with nail-biting as nail biting is frequently associated with anxiety and depression.

2.3.6 Aetiology 6: Nutritional deficiency

A body of aetiological research investigates nail biting in relation to nutritional deficiency and how it may be significant because the food we eat is one of the fundamental influences on our health. This part of the discussion scopes into the connection between nutrition and the central nervous system and how it may directly contribute to the cause of nail biting and nail biting co-occurring symptoms or disorders. This is presented in a variety of case studies involving the analysis of patients on dosage of a specific chemical compound.

In the late 1800s, a Japanese doctor, Sagen Ishizuka, who had great success in treating people with serious health problems, studied the effect of diet and health. His research led him to conclude that the correct balance of the potassium and sodium minerals in the body was the fundamental determinant of optimal health. Food is the main factor in maintaining a good balance of potassium and sodium minerals. A good balance of potassium and sodium will help the muscles, cells, nerve transmissions and many processes to function properly as well as to maintain ideal electrolyte and acid balance in the body. Dr Ishizuka treated George Ohsawa's tuberculosis by using a healthy diet of whole, living, natural foods eaten in seasons. Ohsawa recovered completely by following the diet treatment. Ohsawa was so grateful to Dr Ishizuka and believed in his theory that he continued Dr Ishizuka's research. He later developed his own philosophy on diet and health based on Dr Ishizuka's work. Ohsawa is generally considered the founder of Macrobiotics which means great life or good health by eating a healthy diet (Brown, 2005).

In accordance with Dr Ishizuka and Ohsawa's theory about diet, the Dieticians' Association of Australia (DAA, 2011) also noted that the human body in good health required adequate nutrients for tissue maintenance, repair and growth. Sufficient minerals, vitamins, proteins and others nutrients could be met only through healthy diet from a wide variety of nutritious food sources. Especially, it is essential that

children must meet their special nutrition requirements for growth and healthy development (DAA, 2011). These suggestions are in accordance with the Australian Institute of Health and Welfare that good nutrition can minimise many health risks factors. Food is the fuel of our body energy, medicine for sickness and nourishment (AIHW, 2011). If eating in stressful environments, the body may not produce enough acid to digest protein properly; thereby, the undigested peptides pass through the system and may contribute to mental problems, irritable bowel and allergic disorders (Schuessler & Collin, 1984).

"You are what you eat," the old saying goes. If this line of thinking is correct, then one may assume that nail biting may be associated with what the nail biters eat. Results of a study showed the association between nail biting and the most frequent eating disorders (Cavaggioni & Romano, 2003). This association might shed light on the aetiology of nail biting and future studies.

Another statement of the Dieticians' Association of Australia (DAA, 2011) is that many children often develop fussy eating problem at some stage in childhood; thereby affecting children's health. As we already know, nail biting is frequently and mostly initiated in childhood. A connection between fussy eating in childhood and the initiation of nail biting in childhood might further support the micronutrient deficiency hypothesis of nail biting.

In accordance with the importance of diet in health conditions, a medical doctor (Hungerford, 2008) wrote in her book "Doctors who sit in with vets will notice one big difference between human medicine and veterinary medicine. Whether it is a sick household pet or an ailing stud bull, one of the first questions is always 'What are you feeding this animal?'. Although a 'good diet' was discussed in medical school, we were never taught that this line of enquiry might help us when a child came in with his fourth middle-ear infection for the winter, or recurrent abdominal pain, or chronic constipation." (p.20)

Another author of a book, *Orthomolecular Medicine for Everyone*, Abram Hoffer, also agree that the basis for good health is good nutrition and hence the basis for effective management of health problems is clinical nutrition, also known as

orthomolecular nutrition or orthomolecular medicine. The word “orthomolecular nutrition/medicine” was coined by a Nobel-prized winner Dr Linus Pauling in 1968. It is a medical practice of using optimum amounts of vitamins and minerals as the main treatment (Hoffer & Saul, 2008).

Studying biochemistry will help understand health and disease. Enzymes are crucial in human biochemistry. Without enzymes, co-enzymes and co-factors, many biological reactions take place very slowly. Fundamentally, many enzymes cannot work without the presence of co-enzymes. Co-enzymes are vitamins and minerals. Nutrition from food operates as an infinitely sophisticated biochemistry in the body which involves countless food chemicals and countless effects on health. For example, spinach contains abundant amounts of various chemical components: minerals (calcium, iron, magnesium, phosphorus, potassium, zinc, and selenium), amino acids (tryptophan, threonine, isoleucine, leucine, lysine, methionine, tyrosine, Cystine, etc.), vitamins (C, B1, 2, 3, 6, folate, A, E), fatty acids, protein and water. As soon as we eat this spinach, the spinach’s chemicals interact with the body’s chemicals, and other food’s chemical in particular ways, and as a result, infinitely complex biochemical process occurs. Science still has not fully understood how each chemical interacts with other chemicals and how they all fit together. Therefore, isolated vitamins and minerals supplement cannot give equal benefits to those of whole food (Campbell & Campbell, 2005).

The above explanations are crucial and fundamental for understanding and developing treatment and preventative strategies in nail biting whereby the adoption of a healthy diet should be a core strategy.

2.3.6.1 Nutrition and the central nervous system

Since many nail biters are associated with one or more psychiatric disorders (Ghanizadeh, 2008), it is important to understand how dietary nutrition can affect the central nervous system (CNS). Although many researchers explored the relationship between diet and manifestations such as alertness, anxiety or sleepiness, this relationship has not yet been established by scientific evidence. However, the popular belief throughout the population is that the relationship

between food and the CNS does exist, and cannot be ignored. Furthermore, the behavioural complications of malnutrition are well documented. “Adequate intake of the trace minerals is also necessary for normal brain development, and certain mineral deficiencies, such as those of zinc and iodine, have been implicated in a variety of behavioural alterations such as deficits in long and short-term memory, apathy, irritability, and depression.” (Groff, 2000, p. 27). The focus of this sub-section is to discuss (1) dietary nutrient precursors that are required for the synthesis of selected neurotransmitters, and (2) the effect on behaviour of their dietary manipulation.

2.3.6.2 Nutrient precursors of neuro-transmitters (NT)

Tryptophan, Tyrosine and Choline are common dietary precursors that have neurological effects due to their biochemical conversion to NT. Tryptophan and Tyrosine are amino acids of dietary protein. Choline is rich in lecithin (Watson, 1972). Exploring biochemistry can help understand the relationship between health status and disease. The Nutrient precursors of Neurotransmitters pathway demonstrates when brain cells communicate with other neurones (nerve cells) they may use serotonin which is a neurotransmitter. Firstly, they take protein from food, digested down to amino acid tryptophan, convert it to 5-OH tryptophan (5HT) and finally converted to serotonin. Along the biochemical pathways, they require enzymes, zinc, copper, iron, calcium, magnesium, vitamins B, folic acid, Vitamin C and methyl group. The methyl group is derived from another amino acid (methionine) which is converted to S-adenosyl methionine (SAMe). SAMe is a source of the methyl group. In order to produce methyl group from SAMe, they require B12, magnesium, Vitamin C and folic acid. Methyl group is critical and essential for almost every methylation reaction in the body (Hungerford, 2008; G. Watson, 1972).

Many people taking SAMe for depression found significant improvement in their moods, but others found no difference. The different results of people taking SAMe could be explained in terms of deficiency of co-enzymes such as B12 or magnesium. Therefore, for the biochemical reactions to function smoothly, the diet must

provide a variety of amino acids, minerals and vitamins. Thus, anxiety and depression are among the clinical manifestations of deficiency of magnesium, iron, B-group, vitamins or protein (Talarowska, Szemraj, Berk, Maes, & Gałecki, 2015).

In Cindy Engel's book, *Wild Health* (cited in Hungerford, (2008, p. 435)), the author explained the reasons for which animals are thought to benefit from eating substances that they normally do not eat. She noticed sick animals have been shown to seek medicinal plants which at other times they ignore. She gave dramatic examples of sick elephants and other animals eating soil from a mineral-rich cave in Kenya. Some animals need a particular mineral such as magnesium or sodium, and the mineral often occurs in the presence of other minerals, thereby the craving for particular minerals may reflect a primitive instinct for a mineral-rich supplement.

Dr Hungerford (2008, p. 435) agreed with Cindy Engel and she suggested that "humans have these same instincts as animals, but they have atrophied through conditioned neglect." She noticed that many people still report cravings in pregnancy or when recovering from an illness. She also raised an insightful question "A child who eats dirt in our culture is regarded as disturbed, and an adult who does the same thing is assumed to be retarded or psychotic. But perhaps they are self-medicating?" (Hungerford, 2008, p. 468).

2.3.6.3 Food as medicine: Eating good food

Food is essential in providing energy, nourishment and comfort. In Dr Hungerford's book, *Good Health in the 21st Century*, she mentioned the super food which contained super nutrient properties with essential minerals such as magnesium, calcium, iodine, selenium and essential fatty acids. These super foods include fish, algae and seaweed. The reasons for these foods to be outstanding may be because they contain nutrients in almost perfect proportion to the requirements of both animal and plant kingdoms. She related these benefits to "the extraordinary health benefits to the Japanese whom have a diet primarily based on fish, algae and seaweed" (p.434).

2.4 Treatments of nail biting

Appropriate treatments of nail biting are crucially needed in order to prevent adverse health problems, thereby improving the quality of life and reducing costs to the government and sufferers. Overall, a review of the literature suggests that control or correction of nail biting disorder usually involves the modification of cognitive-behavioural patterns (psychotherapy), medication therapy, and education and awareness raising approaches.

2.4.1 Cognitive-behavioural therapy or psychotherapy

Cognitive-behavioural therapy or psychotherapy targets the thought and the action of nail biting. Various behaviour-modification techniques have been used to decrease nail biting including, but not limited to, habit reversal training, non-removable reminders, self-control, aversion therapy, hypnotherapy, and punishment. Each of these therapies is detailed in the following sub-sections.

2.4.1.1 Habit reversal package

By definition, habit reversal training is a "form of behavioural therapy, which uses a similar or dissimilar competing response" (Ghanizadeh, 2011, p. 76) to eliminate habits such as fingernail biting. First proposed by Azrin and Nunn (1973) to eliminate nervous habits and tics, habit reversal therapy has been reported to have positive effects in several studies (Dufrene et al., 2008; Ghanizadeh, Bazrafshan, Firoozabadi, & Dehbozorgi, 2013; Long et al., 1999; Woods et al., 1999). For example, habit reversal has been reported to be helpful in reducing many behavioural problems, including skin picking (Teng, Woods, Marcks, & Twohig, 2004), compulsive hair pulling (Woods, Wetterneck, & Flessner, 2006), and even reducing the tics associated with Tourette Syndrome (Watson, Dufrene, Weaver, Butler, & Meeks, 2005). This therapy consists of awareness training, relaxation training, competent response training, and contingency management. More specifically, the basic components may involve the assessment of the time, situations, and other issues associated with the occurrence of the habit, the

identification of a reasonable replacement behaviour, and the training to replace the habit with an incompatible response (Waller et al., 2007).

A randomised control study compared the efficacy of habit-reversal cognitive-behavioural therapy with a placebo control group (Twohig, Woods, Marcks, & Teng, 2003). The habit reversal group received training of awareness, competing response, and social support. The control group received a simple discussion about nail biting. Nail lengths were measured at pre-treatment, post-treatment, and a 5-month follow up. The evidence from this research suggested habit reversal was significantly more effective than the placebo control (Twohig et al., 2003). In accordance with Twohig's findings, a former study investigated habit-reversal treatment for fingernail biting in 40 adult nail-biters (Horne & Wilkinson, 1980). The participants were divided into three experimental groups and a placebo group; the first group used habit reversal plus nail care; the second group used habit reversal nail care plus program of ongoing target goals; and the third group used the nail care instructions plus program of ongoing target goals. The measurements were length of nails and absence or presence of nail biting; the results showed significant greater improvement in fingernail length in the control group, but, at follow-up, the two groups incorporating habit reversal showed much lower relapse rates than the third group and the control group. The evidence supported the argument that the habit-reversal treatment is the key component in effective treatment of the compulsive habit of nail biting (Horne & Wilkinson, 1980).

Similarly, Long et al. (1999) assessed the value of simplified habit reversal in the treatment of nail biting and other oral-digital habits exhibited by individuals with mental retardation. They found that simplified habit reversal showed little effect when used in isolation. However, when combined with remote prompting, remote contingencies, and differential reinforcement of nail growth, this treatment contributed to decrease the behaviour to near-zero levels for all participants. Directions for future research involving therapist-mediated treatment procedures, particularly those involving remote prompting and remote contingencies, are encouraged accordingly.

More recently, Ghanizadeh et al. (2013) carried out a parallel three-group randomised controlled clinical trial on 91 children and adolescents with nail biting, to investigate the efficacy of habit reversal training in comparison with object manipulation training. The findings of their trial showed that the former was more effective than the latter in increasing the mean length of nails of children and adolescents in the long term.

An important stage in the habit reversal package is the functional assessment. From a cognitive perspective, nail biting as a learned behaviour is maintained by positive, negative, or automatic reinforcements. In other words, nail biting habit has a function, which can be identified by an examination of the conditions and situations in which nail biting is likely to occur (Ghanizadeh, 2011). Functional analysis is a method for assessing the nature of precedents and consequences of nail biting, whose positive effect is stable over time (Dufrene et al., 2008). The functional assessment provides a foundation for the behavioural analysis and planning of treatment for nail biting.

Functional analysis was used to guide treatment development and implementation for nail biting exhibited by a 24-year-old female graduate student. A modified habit reversal package was applied, based on results of the functional analysis. The findings indicated a decrease in nail biting as evidenced by consistent nail growth and participant self-recorded data (Dufrene et al., 2008). In their study involving three typically developing children and adolescents, Zawoyski et al. (2014) evaluated the effects of matched and unmatched stimuli on nail biting. The findings indicated the effectiveness of all forms of alternative stimulation in decreasing nail biting.

A combination of behavioural modifications is frequently reported to be enhanced the effectiveness of this habit reversal package. Moritz, et al. (2011), for example, carried out a randomised controlled trial on 72 excessive nail biters to assess the effectiveness of the titled decoupling (DC) treatment, which involved the decoupling and rearranging of behavioural elements of this pathological habit. The results showed that as opposed to the progressive muscle relaxation (PMR)

method, DC was effective in attenuating nail biting. Another study investigated the effect of the simple, noninvasive, and nonpunitive approaches of using coded verbal prompts and habit reversal to reduce fingernail biting in a classroom setting. The participant in this study was a 14- year-old white male whose severe habit of biting finger nails and the surrounding skin frequently distracted him from daily academic tasks, had a significant deleterious cosmetic effect on his hands, and attracted a great deal of unwanted negative attention from peers. He was given a stress ball to squeeze as a replacement for fingernail biting. A coded prompt was agreed upon by Thomas and his teacher as a cue from the teacher that he would use the stress ball. The intervention was monitored for two five-day school weeks. The findings revealed a significant reduction in nail biting (Waller et al., 2007).

Other study findings have been in alignment with the findings above (Silber & Haynes, 1992). A randomised control study compared two methods of treating nail biting in 21 participants over 4 weeks. One method is mild aversion (paint bitter nail polish on nails) and the second method involved a competing response behaviour therapy. The result showed significant improvement in nail length in both methods compared to the control group, also the competing response therapy was superior to the mild aversion method (Silber & Haynes, 1992).

2.4.1.2 Non-removable reminders (NrRs) treatment

Over-correction is another reported approach using the same principle of cognitive behavioural therapy. To determine the value of non-removable reminders (NrRs) treatment for the behaviour modification of nail biting, Koritzky and Yechiam (2011) conducted a study on 80 nail-biters who were resolved to quit. The participants were asked to wear non-removable wristbands which would constantly remind them of their resolution to quit nail biting. Recovery was assessed at various intervals of three weeks, six weeks of treatment and in a five-month follow-up. It was found that the NrRs method was associated with lower dropout rate and was as successful as the aversion-based method.

2.4.1.3 Self-control/ Self-monitoring technique

This method includes the learning and application of some specific self-control skills by the subjects and was described in a study by Ronen and Rosenbaum (2001). First, nail biters are taught that the targeted behaviour is a problem, and they can change it. Second, they are encouraged to identify the possible causes of nail biting and the thought and feelings associated with the behaviour is elicited. Third, nail biters are instructed to do self- monitoring and trained in self-talk and self-reward to manage and change nail biting as well as other similar pathologic behaviours. Early studies in the 70s had indicated that self-monitoring method on its own might work for some nail-biters. However, it is much more effective when combined with additional therapies such as positive or negative reinforcers (Adesso, Vargas, & Siddall, 1979).

Ronen and Rosenbaum (2001) reported on a case study in which a self-control dual intervention model was applied to treat a ten-year-old boy with enuresis and nail biting. The procedure involved the patient being taught self-control skills on enuresis and subsequently encouraged to independently apply these skills to nail bitting with minimal guidance from the therapist. It was found that self-control training could promote children's independent functioning via the ability to apply learned skills to other problematic issues.

In order to treat problematic nail biting, Craig (2010) conducted a self-experiment, utilising self-monitoring and a self-managed differential- reinforcement procedure. The treatment integrity was ensured with the assistance of an independent observer and a picture-comparison procedure. His results confirm the positive effect of the overall treatment package including self-monitoring in decreasing the occurrence of nail biting. Another study by Moritz et al. (2011) also showed that a self-help technique was more effective than progressive muscle relaxation.

Craig (2010) conducted an experiment using self-monitoring in conjunction with a self-managed differential-reinforcement procedure for the treatment of problematic nail biting, which provided evidence for the success of the overall treatment package in decreasing the occurrence of nail biting.

In a reversal-replication (ABAB) research design, Mcclanahan (1995) applied the Operant Learning (R-S) Principles to the treatment of nail biting for a 32-year-old Caucasian woman. During a 28-day study, the systematic desensitisation techniques of deep muscle relaxation and transcendental meditation were used and all details related to nail biting, including frequency, duration, antecedents, and setting events, were recorded. The findings from a preliminary questionnaire and interview suggested that an increase in self-awareness was the most effective in the treatment of nail biting.

2.4.1.4 Aversion therapy

Aversive procedures involve the presentation of an unpleasant consequence of a targeted behaviour (The Australian Psychological Society, 2000). Specifically, this therapy involves the use of negative reinforcement to make nail biting an unpleasant experience for nail biters. Bitter-tasting nail polish is the most widely recognised form of treatment of this type, which has been found to be quite effective.

A four-week study by Silber and Haynes (1992) compared the effectiveness of two methods of treating nail biting, namely mild aversive stimulus and competing response condition. In the former treatment, a bitter substance was applied on the subjects' nails while in the latter; the subjects were required to perform a competing response regarding nail biting. Findings from 21 subjects indicated that both methods contributed to significant improvements in nail length, with the competing response method displaying the highest effectiveness. This treatment also led to significant decrease in skin damage and increase in the subjects' self-rated control over their habit. Allen (1996) conducted a 12-week experimental study on 45 chronic nail biters to determine the effectiveness of different treatment methods, including mild aversion, and competing response. Mild aversion with the use of bitter nail paint reportedly showed significant improvements in nail length, which has practical implications for the treatment success of nail biting.

2.4.1.5 Hypnotherapy

Hypnosis targets the unconscious element of the habit, helping to break the habit for good. In an early case study report, a female adult nail-biter was successfully treated in short-term hypnotherapy (Gruenewald, 1965). This hypnotherapy case proved the hypothesis that resolutions of conflicts and emotional stress of which nail biting was often symptomatic could help to treat nail biting successfully. More recently, another pilot study use hypnotherapy to alleviate chronic nail biting behaviour. The study involved the participation of three highly hypnotisable adult nail-biters. The findings indicated that all three nail-biters experienced immediate improvement in nail biting behaviour and dramatic increase in nail lengths. At the three-month follow-up, two nail-biters still continued to indicate substantial progress (completely stopped nail biting) while one nail-biter moderately resumed nail biting (Bornstein, 1980).

2.4.1.6 Punishment therapy

There is limited research investigating the efficacy of punishment therapy for nail biting. However, two forms of self-punishment methods have been reported as a treatment that attempt to adjust nail biting behaviour. They include a shock device and snapping an elastic ban on the inside of the wrist. A study in the 60s used a portable shock device as a negative reinforcer to treat nail biting (Bucher, 1986). The use of the shock device was impractical and hence this approach did not become established therapy. The more popular punishment method is snapping a rubber band on the inside of the wrist when the urge of nail biting starts. The pain from snapping the rubber band causes a negative physical response to nail biting.

2.4.2 Medication therapy

Various medications have reportedly been utilised to treat the pathological oral habit of nail biting.

Viewing nail biting as an obsessive-compulsive disorder, many scholars have studied the effect of psychotropic medications on nail-biters because these patients are believed to experience an imbalance in neurotransmitters (especially serotonin)

(Pacan et al., 2009). Selective Serotonin Re-uptake Inhibitors (SSRIs) are believed to inhibit the re-uptake of serotonin and noradrenaline into the presynaptic cell, thereby increasing the concentration of these neurotransmitters at postsynaptic receptor sites. SRIs have been used for many years in treating obsessive-compulsive disorders, including nail biting (Hungerford, 2008; Rossi, 2011). A study observed 3 case reports of nail biting with co-occurring psychopathological symptoms (Pacan et al., 2009). The observations showed that SSRIs were effective in the treatment of severe nail biting.

Another class of psychotropic agents (TCA) was also investigated in the treatment of nail biting (Leonard et al., 1991). Clomipramine and desipramine are tricyclic agents (TCA) with both antidepressant and anti-obsessive-compulsive actions. Their actions are blocking re-uptake of noradrenaline and serotonin (neurotransmitters) into central nerve terminals, thereby increasing the levels of these neurotransmitters at receptor sites (Rossi, 2011). A double-blind study compared the effects of Clomipramine and Desipramine in treatment of severe nail biting (Leonard et al., 1991). The sample consisted of 14 adult nail biters. It included a placebo trial and a double-blind balanced-order comparison of 5 weeks each of clomipramine and Desipramine treatment. The subjects completed a 12-week outpatient study. The results indicated that Clomipramine led to far greater improvement in nail biting than Desipramine (Leonard et al., 1991). The actual mechanism of the action is unknown, but clomipramine is assumed to influence obsessive-compulsive habit (such as nail biting in this context) through its effects on its capacity to block serotonin reuptake. Clomipramine's capacity to inhibit serotonin reuptake is stronger than Desipramine (Rossi, 2011). This may explain why clomipramine is a better treatment for nail biting than Desipramine.

N-acetyl cysteine (NAC), a widely available nutraceutical with antioxidant properties, is another type of medication to be in use for nail biting treatment. Berk et al. (2009) reported on three cases in which N-acetyl cysteine (NAC) was used to treat nail biting and associated anxiety. In the first case, a 46-year-old woman, once diagnosed with bipolar disorder and an excessive life-long nail biter since childhood, was treated with NAC 1,000 mg BID. At the first follow-up visit, two weeks after the

trial, she reported having "stopped biting her nails" without consciously seeking to stop it. Seven months later, she had still not bitten them and her nails had regrown strong without any ridges. In the second case, a 44-year-old woman, a lifelong nail biter, had symptoms of depression and anxiety for most of her life and was diagnosed with rapid cycling bipolar disorder. After 4 months on NAC 1,000 mg BID, she reported ceasing nail biting for the first time in a decade. Two months later, she had not resumed nail biting and reported feeling relaxed enough to consciously stop biting nails, especially after noticing the growth of one nail. The last case was a 46-year-old man with a long-standing habit of biting nails and the surrounding fingers' skin, who had experienced depression since adolescence and was first diagnosed with bipolar disorder at 45 years of age. After 28 weeks since the start of the NAC trial, he reported a reduction in nail biting although it was not a conscious resolution to treat his behaviour. According to Berk et al. (2009), "Via its additional effect on glutamate via the Cystine-glutamate exchange system, NAC has been shown to mediate impulsivity in preclinical models of addiction, reduce craving, and cue extinction" (p.357). It is still unclear as to the exact mechanism of action of NAC in these three cases. However, the findings from these case reports warrant more research regarding the potential role of NAC in nail biting.

Contemporary researchers also provide evidence for the effectiveness of antipsychotic and an antidepressant in treating nail biting. For example, Tre Michopoulos and his colleagues (2012) reported on a case of a 66 year old man with severe finger mutilation as a result of serious nail biting for six years. His self-mutilating behaviour was associated with severe diabetic neuropathy, impulsivity, and social isolation. It was found that the administration of a combination of an antipsychotic and an antidepressant was beneficial.

2.4.3 Healthy nails program

Apart from the cognitive-behavioural therapies that seek to make adjustments to the behaviour of nail biting, healthy nail programs are also used as a preventative measure to heighten the awareness of children and parents.

In a quasi-experimental study to examine the effect of a healthy nails program on nail biting among Turkish schoolchildren, Ergun, Toprak, and Sisman (2013) reported evidence for its effectiveness in reducing the nail biting problem in schoolchildren. A total of 103 students were involved in this pretest-posttest control group intervention. Data from a demographic form, a nail biting follow-up form, and photographs of the fingernails revealed that 68.9% of the students were biting seven or more of their nails; and 46.6% had damaged nail beds. In the intervention group, the rate of the children who were not biting their nails increased significantly compared to the control group. Their positive findings on healthy nails programs are in alignment with the proposal by Sachan and Chaturvedi (2012) for awareness raising, and good habit stimulation, such as keeping the nails well-trimmed as alternative measures for nail biting. With the same viewpoint, Hedge and Xavier (2009) stressed the need to encourage the maintenance of good hygiene, highlight the cultivation of healthful habits and at the same time discourage the ill practices, like nail biting. In support of this educational approach, Ghanizadeh (2011) proposed the involvement of parents and siblings in these health promotion programs, who could provide support and confidence to nail biters in their efforts to cease pathological nail biting.

2.5 Conclusion

This chapter has provided a review of research in the field that has been compiled and organised thematically into the subsections of nail biting risks and complications; possible causes or related aetiological theories of nail biting; and treatments of nail biting. Major research studies about these themes have been reported and discussed thoroughly in this chapter, providing a solid theoretical and conceptual background for the study. It has been found that nail biting is associated with a variety of health issues, including dental risks, nail injuries, infections, social issues, and many psychological disorders. Regarding its possible causes, the case studies presented provide strong evidence for the contribution of both psychological factors and physiological factors to nail biting. Even though there is no single theory that satisfactorily explains the underlying causes of nail biting, a

review of the literature affirms that it is directly or indirectly linked to a range of aetiology such as OCD, anxiety, tension, stress, nervousness, genetics and mineral theories.

An extended discussion has been devoted to the findings related to the association between nail biting and the mineral imbalance or nutritional deficiency theory.

The concept behind minerals is derived from the fact that inorganic minerals are essential elements of the body, especially with the physiological healing process. If minerals are deficient or imbalanced, the body will respond in a variety of physical or mental symptoms. Nail biting could be one of the most common forms. The case studies presented on both sides indicate that there may be a clear process behind the cause and effect of nail biting. The deficiency or imbalance of minerals in the body may be associated with the initiation of nail biting, and the end product and co-occurring problems that develop from this can be identified in the psychological conditions mentioned in the literature.

The next chapter will offer an overview on the methodology employed in the study.

3 Research Methodology

3.1 Introduction

As highlighted in the preceding Literature Review chapter, research evidence concerning nail biting and long term treatments of nail biting is inadequate and inconclusive. Moreover, the possible association between micronutrient deficiency and nail biting is still lacking and under-examined. As a result of this, there is a range of different views and experiences from health professionals and nail biters.

This chapter describes the research frameworks and the study design to address the research questions and achieve the aims of the study. It discusses in depth the rationale and the methodologies used for data collection. Specifically, it elaborates on the justification for the adoption of a mixed method design in the study, which included both quantitative and qualitative approaches. It then describes the study population and the sample selection of health practitioners, current-nail-biters, ex-nail-biters and parents of nail biting children. It also outlines the data collection instruments (questionnaires and semi-structured interviews), data collection procedure, and analytical and statistical methods for data analysis. This chapter as a whole justifies the research orientation and the chosen methods in the study.

3.2 Theoretical framework and research design

3.2.1 Theoretical framework

Theoretically, every research effort is underpinned and directed by a school of thought about what is knowledge (ontology), how we know it (epistemology), what values go into it (axiology), how we know it (rhetoric), and the process for studying it (Creswell, 2003). So far, there have been many basic schools of thoughts, including positivism, post positivism, socially constructivism, pragmatism, and advocacy/participatory paradigms.

The first school of thought, positivism, is a theory building approach encompassing a variety of forms such as Comtean positivism, logical positivism, and behaviourism, all of which seek to verify hypotheses. Positivism assumes the existence of an independent reality with its own natural laws and mechanism, which researchers can study without influencing them or being influenced by them (Guba & Lincoln, 2011). A general criticism of this approach is related to its disregard of contextual elements and over-reliance on a reductionist view to search for universal mechanistic rules.

Post-positivism is similar to positivism in that the knowledge construction is based on a careful observation and measurement of the objective reality that exists in the world. However, addressing the shortcomings of positivism, post-positivism assumes that reality is only imperfectly and probabilistically apprehendable (Forbes et al., 1999). As a result, research underpinned by this school of thought attempts to make claims and then refine them for more strongly warranted claims (Creswell, 2003). Bound by the contexts, findings are not generalisable to all cases and situations and post-positive research tends to indicate a failure to reject hypotheses rather than verifying them (Carpiano & Daley, 2006).

Another school of thought, which is essentially an anti-realist, relativist stance, is social constructivism (Hammersley, 1992). Social constructionism coincides in part to the interpretivist approach to thinking, in which meanings are created, negotiated, sustained and modified (Schwandt, 2003). Therefore, socially constructivist researchers develop knowledge through the subjective interpretation of meanings of lived experience directed towards certain objects. Because these meanings are varied, the researchers often investigate the complexity of views rather than narrowing meanings into a few categories or ideas (Creswell, 2003). The goal of research is then not to verify a hypothesis, but to generate or inductively develop a theory or pattern of meanings.

The next school of thought about knowledge claims is pragmatism (Creswell, 2003). According to Blumer (1969), the essence of pragmatist ontology is actions and change because the world is in a constant state of becoming. He claims “the

essence of society lies in an ongoing process of action – not in a posited structure of relations. Without action, any structure of relations between people is meaningless. To be understood, a society must be seen and grasped in terms of the action that comprises it" (p.71). In other words, the focus of pragmatism is not only on the present states or reality of the world but also on an orientation towards a prospective world. Therefore, the main aim of pragmatic research is to discover knowledge, in all forms of explanatory, descriptive, prescriptive, normative and prospective, to make a purposeful difference in practice, to better manage existence or better taking part in the world (Goldkuhl, 2012). Under this orientation, whereby knowledge claims arise out of actions, situations, and consequences, research problems are the most important apart from methods. In terms of methods, researchers tend to place an importance on forming the research problem and then using pluralistic approaches to derive knowledge about the problem (Creswell & Plano-Clark, 2007).

The final school of thought to be included in this discussion is advocacy or participatory knowledge claims, in which the researchers claim knowledge through an advocacy or participatory approach. It was believed that other schools of thoughts had a tendency to impose laws and theories observed and constructed by certain individuals, which may not fully address social issues that involved marginalized individuals (Creswell, 2003). Therefore, participatory researchers aim to empower the research participants, who are often community members or community-based organisations in the construction of knowledge. Research studies supported by participatory approach are designed to provide opportunities for these participants to raise their voices, heighten their consciousness or advance an agenda for change to improve their own lives.

In order to investigate the research questions related to the multi-dimensional issue of nail biting, including its causes, effects, and treatments, the present study was underpinned by several of these schools of thought. Specifically, it was guided by social constructivism in the subjective interpretation of meanings of lived experiences to search for answers to the research question. In addition, it aimed to explore the complexity of the issue and through that exploratory process,

inductively develop a theory behind the causes and treatments of nail biting. The present study was also influenced by pragmatism and participatory schools of thoughts in that its ultimate purpose was to make a difference to the current practice nail biting prevention and treatment, especially through the involvement of different community members in its answer-finding process.

3.2.2 Research design

Research design, which is the planning and structuring of the conduction of research from identifying the problem through to reporting and publishing the results (Punch, 2005), largely contributes to the achievement of the objectives as well as the reliability and validity of a research study. According to Creswell (2003), research design includes research approach, research methods, and data collection.

Research approach is a set of assumptions and concepts held by researchers (Creswell, 2003; Johnson & Christensen, 2004) in search of answers to the research questions. Two most prevalent research approaches across all fields in general, and health sciences in particular, are quantitative and qualitative methods.

3.2.2.1 Quantitative versus qualitative approaches

Quantitative approach is underpinned by the positivist or scientific paradigm, with a focus being placed on certain properties, states and characters of phenomena, and the similarities, differences and causal relations within and between these (Leedy & Ormrod, 2005). The scientific value of this approach is largely grounded on numerical data and statistical analysis. Accordingly, quantitative researchers often adopt objective standardised questionnaires and quantitative measuring tools to test a hypothesis or investigate the relationship between variables.

On the other hand, qualitative approach is promoted by the interpretivist or constructivist paradigm, which is largely inductive, descriptive or exploratory in nature (Yin, 2009). This approach relies on textual data, rather than statistical data, to probe the depth of meanings of a phenomenon in a social context and inductively develop theories instead of testing pre-established ones (Johnson &

Christensen, 2004). Therefore, thoughts, feelings, perceptions and lived experiences of human are to be examined and interpreted by qualitative researchers (Burns, 2000; Corbin & Strauss, 2008). Qualitative researchers, for that reason, also tend to be more subjective than their quantitative counterparts, and often conduct interviews, focus groups, or case studies to collect rich textual data (Johnson & Christensen, 2004).

3.2.2.2 Mixed methods approach

Both of these approaches have their own strengths and limitations. As observed by Rapport (2004), the methodological issues of qualitative approach lie in its reliance on subjective interpretation of lived experiences, while quantitative approach is too obsessed with producing standardised and generalised outcomes, failing to reflect social construction, cultural change, and individual experience. The good thing is despite their contrasting natures, these two approaches are not mutually exclusive. To address the limitations of each method and eliminate their biases, the mixed methods approach combining both quantitative and qualitative approaches has been proposed. It is suggested that the combination not only reduce the conflicts between the two paradigms, but also offset the weaknesses of both approaches (Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007). In this mixed methods design, effectiveness is ensured by complementarity between positivist and interpretative perspectives, between objectivity and subjectivity, and between statistical and textual data (Johnson & Christensen, 2004). Specifically, mixed methods researchers could address the issue of interest both deductively and inductively. For example, a hypothesis could be objectively deducted in the quantitative phrase, which is then further supported or explained qualitatively (Frechtling & Sharp, 1997). For those reasons, mixed methods approach guarantees the collection of broader and deeper data, thus, providing a better understanding of the issue under study.

3.2.2.3 Concurrent triangulation mixed methods approach

On account of the advantages of combining both quantitative and qualitative approaches, a mixed methods approach was adopted in this present study to explore all of the complexities surrounding nail biting. The quantitative approach

sought to yield representative information about the perceived causes, effects, and treatments of nail biting among nail-biters, parents of nail biters, and health professionals. In addition, the qualitative approach aimed to interpret, probe further or validate the quantitatively obtained information. The combined data would enable the researchers to have some general observations about nail biting habit among children and teenager, and simultaneously, to examine in depth the individual differences that may arise from participants' lived experiences and perspectives. With this effective integration of both qualitative and quantitative data collection methods, the study was believed to achieve a more thorough understanding of the researched issue, especially concerning the identification of the challenges nail biters face, the root causes of nail biting, and possible treatment approaches.

Creswell et al. (2003) defined several types of mixed methods with a combination of approaches, including sequential exploratory, concurrent triangulation, concurrent nested and concurrent transformative approach. These approaches take into consideration the particular method of data collection and how the data are subsequently 'integrated' into the process. The end-to-end process commences at the sequential approach, where the facilitation of data collection takes place. This approach sequentially collects one group of data before another, which informs the next data collection step in the process. On the other hand, the concurrent approaches collect all the data at the same time. The data from the many different approaches may then be combined at the interpretive or analysis phase as established by the theoretical perspectives used within the process.

In the present study, questionnaires were used in the quantitative phase and semi-structured interviews were used in the qualitative phase. These two instruments had different focuses and natures although they were designed to complement each other in the investigation of nail biting. Therefore, the concurrent mixed methods approach or triangulation was used in which the quantitative data and qualitative data were collected roughly at the same time and merged during the interpretation phase. Figure 3.1 below summarises the research design in this study.

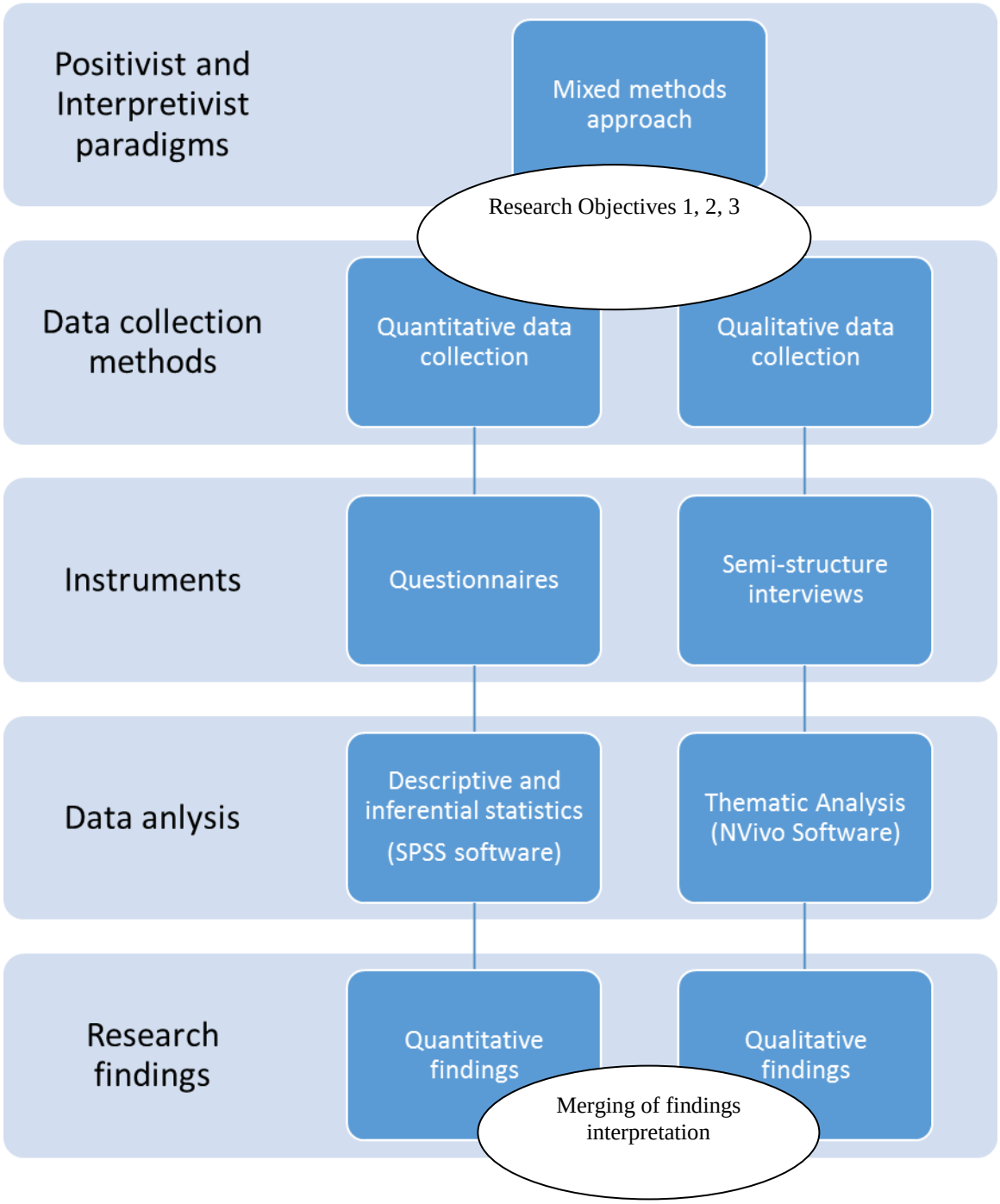

***Figure 3-1*: The study's research design**

3.3 Data collection

Data collection, in both quantitative and qualitative phases, involved the development of research instruments, the sampling process, participant recruitment, and the data collection procedure. Each of these steps is described in detail below.

3.3.1 Survey questionnaires

The quantitative method used a cross-sectional design, which employed survey questionnaires for data collection. Survey questionnaires have been widely used by researchers across disciplines as they have many advantages. Specifically, questionnaires are the most practical and cost-effective way of reaching a large and wide-ranging sample (Cohen, Manion, & Morrison, 2007). Other advantages include time effectiveness, ease of completion for the respondents, and ease of tabulation for the researcher. In addition, with structured and uniform questions, the use of questionnaires could minimise bias and interference from the researcher, thus inducing more reliable responses (Bornhöft et al., 2006; Robson, 2002). In this study, questionnaire were used to gather the opinions and experiences of health practitioners, nail biters, and parents of nail biting children in a cross-sectional survey design, which provided a good overview of different opinions, thoughts, feelings and experiences in relation to clinical, social, and psychological dimensions by a large number of people. The results from the questionnaires would produce a 'snapshot' of the target subjects, which could help identify the similarities or differences and provide an analytical and descriptive summary of the overall result. For example, different health professionals might have different experiences, knowledge, approaches and points of view on nail biting among children. For example, a psychologist or psychiatrist might attribute the underlying cause of nail biting to anxiety or a psychological problem whereas a pharmacist or a naturopath relates it to particular minerals or nutrition deficiency. Their approaches to treating nail biting in children may also vary. Moreover, the cross-sectional study is inexpensive and convenient in relation to finance, time and resources compared to longitudinal and cohort studies. Due to time and finance constraints of the PhD

program and the scarcity of funding, the use of questionnaires was appropriate, practical and economical.

3.3.1.1 Questionnaire design and development

There are a number of general considerations in the development of a satisfactory questionnaire (Bowling, 2005). The whole process of questionnaire design and construction in this study covered several important steps to ensure the validity and reliability of the research instrument. They included: identifying the conceptual domains, questions, and scales; developing the draft questionnaires; validating the questionnaires; and refining the questionnaires.

3.3.1.1.1 Domains for questionnaire

The first step in developing questionnaires is to identify the information needed to support research questions and the hypothesis. A continual reading, review of the relevant topics of the study, research questions and hypothesis, will keep the questionnaire focused and avoid unnecessary questions. In this study, the key domains were constructed from the literature review and the research framework. The table below is a summary of these domains, variables, definitions and descriptions.

Table 3-1: ***Domains of questionnaire, their variables and definitions***

Domains	Variables	Definitions
Frequency of nail biting	Current, past, number of nail biting a day.	The number of actions of putting the finger nails or toe nails in the mouth
Proposed causes of nail biting	Anxiety, mineral imbalances, psychological disorders, poor diet, others.	Different views of the main factors that cause nail biting.
Complications associated with nail biting	Dental problems, poor diet, infections, skin damages, muscle pain, eyes twitching.	Dental problems: gum infection, gum bleeding, toothache, worn teeth, crack tooth enamel, teeth falling out, nail embedded between teeth. Infections: cold & flu, fungal infections, cold sores, skin infections and skin infections. Muscle pain: neck pain and stiffness, legs pain and cramps. Poor diet: fussy eating, inconsistent diet, and lack of variety in diet.
Treatments for nail biting	Bitter nail polish, hypnosis, punishment, psycho- therapy, mineral supplements & medications.	Bitter nail polish- a very bitter taste inert chemical. Hypnosis- a trance-like state, in which the person's thoughts and actions can be influenced by a hypnotherapist.
Milk intake	Amount of milk consume a day	Milk is a rich source of calcium that is required for growing in children.
Fussy eating	Red meat (beef, lamb), chicken, cheese, nuts, pork, vegetables, fruits.	Things that the person does not like to eat and tend not to eat.
Social issues	Bullying, anti-social behaviours, isolation, etc.	
Health issues associated with nail biting person	ADHD, bed wetting, anxiety, Tourette syndrome, depression, jaw joint pain, psychiatric disorder and oppositional defiant disorder.	ADHD: Attention deficit hyperactivity disorder.

3.3.1.1.2 Questions and scales

A search for published articles, books and websites related to nail biting was conducted in order to identify appropriate questions and scales to fit the relevant domains. The keywords used to search relevant questionnaires and scales were:

- Nail biting
- Onychophagia
- Nail biting in children
- Mineral deficiency and nail biting
- Psychological disorders and nail biting
- Children and fussy eating
- Nail biting and treatments
- Mineral therapy
- Mineral status analysis
- Children and nutrition deficiency
- Common mineral deficiency in children
- Magnesium and children

The search was conducted via Medline, PubMed, online Wiley Library, Scholar Google search and Primary search.

3.3.1.1.3 Development of questionnaire

3.3.1.1.3.1 Formulating questions and scales

Two basic types of questions were employed in the questionnaire: closed ended and open-ended questions. The former type is structured while the latter one is

unstructured. Both types have advantages and limitations, and thus were combined to complement each other in the study's questionnaires.

Open-ended questions are pre-coded questions that are prompted by a full range of possible alternative answers. Participants could select one or more of the pre-coded answers provided. Two main concerns in developing the open-ended questions were the number of alternatives/options and the order bias. The alternative answers were developed collectively exhaustive and mutually exclusive. In addition to the suggested alternatives, an "other" (please specify) category was included in all the multiple-choice questions. Instructions were also included to ensure survey respondents were clear about what to do, such as whether to select only one answer or choose all that apply. If the alternative choices are too long, respondents might find the questions more difficult to answer, hence might be discouraged from completing the survey. Therefore, the researchers broke down the questions to more than one to simplify the workload for respondents. Order bias is the respondents' natural inclination to select an alternative simply because the answer choice appears at a certain position in a list. Alternatives that stand at the beginning and at the end of a list are often selected the most compared to the answers in the middle in a list. To prevent this order bias, several versions of the questionnaire were prepared with different orders of the answer choices.

The closed-ended questions are generally easy for respondents to complete. They are also easier to analyse, tabulate and compare information than open-ended questions. In general, respondents are inclined to cooperate and complete the survey if the questions are structured with closed-ended questions. However, it is more challenging to develop a list of exhaustive alternatives in the answer for this type of questions. Moreover, the list of alternatives itself can be biased. To overcome this shortcoming, open-ended questions were employed.

3.3.1.1.3.2 Open-ended questions

Unlike close-ended questions, open-ended ones are unstructured and allow respondents to freely express their views, attitudes and opinions without bias associated with predefined alternatives. Therefore, they are helpful in investigating

underlying causes, motivations, beliefs and attitudes in exploratory studies. They also help researchers understand the multiple choices questions more clearly and form an essential component to their exploratory study. The current nail biting study employed the open-ended questions mainly in the interviews and a few of them in the survey questionnaires.

3.3.1.1.3.3 Structuring questionnaires

It is important to take into consideration the characteristics of the respondents, the language used and the context of the questions as respondents may have different educational levels, experiences, and backgrounds. For example, the language and context used for health practitioners may not be appropriate for the parents of nail biting children. If technical terms or medical terms are used in the questionnaire for the parent respondents, there might be a high incidence of uncertainty or no opinion responses. Therefore, for parents of nail biting children, simple words and plain language were used in the questionnaires.

Another issue to consider was the order of the questions, which could affect the results of the survey. It is suggested by survey experts that whenever possible, early questions in a questionnaire should be easy and pleasant to answer to encourage respondents to continue and complete the survey. Therefore, in the two questionnaires of the survey, the more difficult closed-ended questions and open-ended ones were placed towards the end of the survey.

The order of the choices on a scale is also believed to make questions more pleasant or odd, easier or more difficult to answer. According to the survey guidelines, the more logical or natural order for the choices is to present “True” followed by “False” or “Agree” to “Disagree”. For the same logic, positive to negative and excellent to poor rating scales should be presented in those natural orders. All of these guidelines were observed and followed in the building of the two questionnaires in this present study.

3.3.1.1.3.4 Questionnaire design checklist

When drafting the two questionnaires, a design checklist was used as follows:

1. Validate that all the information gathered fully addresses the overall components of the research problems.
2. Understand the key aspects of the target population.
3. Is the question relevant?
4. Avoid using questions that have two different aspects to the subject.
5. Have the respondent been informed?
6. Is the question too long?
7. Does it require great effort to answer?
8. Is it sensitive?
9. Is it easy to understand?
10. Do the multiple-choice questions include all the response alternatives?
11. Is the question order bias?
12. Does it have many ambiguous words (such as usually, normally, frequently, often, regularly, occasionally, sometimes)?

3.3.1.1.4 Expert review

After the completion of questionnaire design, it is important to have experts to examine the questionnaire for potential problems. Experts can be survey methodologists or survey researchers with extensive experience in writing and administering questionnaires, who could identify problems and may recommend possible solutions such as rewording, reordering questions, examining scales and questions to ensure sufficient coverage of the domain areas of the research.

In this study, three experts with extensive experience in research and relevant field of research were invited to review the two questionnaires. All three experts

willingly accepted the invitation to review the questionnaires. A review package was sent to them, including the following documents:

- A summary of the background and the goals of the study;
- Literature review chapter;
- A draft questionnaire; and
- Questionnaire design checklist.

All of the returned comments and suggestions, such as removal of technical terms or medical jargons in the questionnaire (e.g., compulsive disorders, misguided perfection instinct etc.); rephrase the questions to make them easier for the participants to answer "Why do you think children bite their nails?" to "What is your understanding of the most common causes of nail biting?"; corrections of typographical errors, etc. by the three experts were carefully noted and the two draft questionnaires were revised accordingly.

3.3.1.1.5 Questionnaire pre-test

Another important step in questionnaire formulation is to conduct a trial of the questionnaire with a group of sample respondents before the main survey administration. The main purpose of a trial or pilot study is to detect and improve weaknesses in the questionnaire design that can have an influence on the findings and hance the achievement of the research objectives. Questionnaire pre-testing or piloting is highly advocated by researchers to validate the research procedures during the phase of data collection, and consequently enhancing the validity and reliability of the main research (Glesne & Peshkin, 1992; Wolf, 1997); particular, this step of pre-testing questionnaires is reported to greatly assist the investigator to identify any unanticipated issues such as wording, instructions, level of difficulties in answering the questions, and length of the questions. In this study, questionnaire pre-testing was conducted with two different groups of target respondents, including nail biters/parents of nail biters and health professionals. They were invited to join the trial run of the questionnaire and responded to a checklist

(Appendix 8) about various aspects of the questionnaire, including format, content, wording, and completion time.

Pilot Questionnaire Checklist

1. How long did it takes for you to complete the questionnaires?..... minutes
2. Did you complete the questionnaire in one session or over two or more sessions?
3. How did you find the length of the survey?
    a. Fine
    b. Too short
    c. Long but bearable
    d. Too long
4. How did you find the wording of the questions?
    a. Fine
    b. Easy to understand
    c. Too technical
    d. Too difficult to understand
5. Did you find any of the questions offensive or too sensitive?
    a. No
    b. Yes (please specify which question): ……..
6. How did you find the size of the print?
    a. Readable

b. Difficult to read

7. How did you find the instructions?

    a. Easy/understandable

    b. Hard to understand

8. Did you find the questions are repetitive?

    a. No

    b. Yes (please specify the repetitive questions): …….

9. Do you have any comments about the survey?

The suggestions and feedback (e.g., removal of many medical jargons and repetitive questions/options, shortening the questionnaires from 35 to 17 question items, increasing the font size for readability, corrections of typos, etc.) from the two groups of questionnaire trial participants were then utilised to make appropriate adjustments. Thanks to this process, the questionnaires were believed to be well suited to the target respondents.

3.3.1.1.6 Final versions of the two questionnaires

After the whole process of drafting, revising, and refining, the quantitative instruments of the present study consisted of a four-page A4 booklet of "Questionnaire for nail biters or the parents of nail biting children" (Appendices 2 and 3) and a three-page A4 booklet of "Questionnaire for health professionals." (Appendix 4)

The questionnaire for parents composed of 17 items divided into two main sections. Section A covered three items of general questions about the nail biting child or nail biter, such as age, body weight, body height, and whether the child / nail biter was a past or current nail biter. Section B included a range of questions related to the nail biting habit and health status of the nail biting child or nail biter. Specifically, they were related to the duration and frequency of the child's / nail biter's nail

biting habit; the perceived most common cause of nail biting; the nail biting related health problems suffered by the child or nail biter; the utilised treatment methods and their effectiveness; the child's or nail biter's diet preferences; current medications or supplements taken by the child or nail biter; the child's or nail biter's co-occurring health issues diagnosed by doctors; and possible social issues experienced by the nail biting child or nail biter. At the end of the questionnaire, an open-ended question was included to invite for parents' or nail biters' further comments and suggestions.

The questionnaire for health practitioners consisted of seven items that aimed to explore their views and experiences in dealing with nail biting among children. Specifically, the questions were related to their profession (medical doctor, pharmacist, naturopath, or others); their perceived most probable cause of nail biting; observed health issues and disorders of nail biters; and recommended treatment methods.

The questionnaires for parents of nail biting children / nail biters were presented in the following order:

1. General questions: participant's / child's age, body weight, height, nail biting status (current or past), duration of nail biting condition, and frequency of nail biting.

2. Common cause: covering anxiety, mineral, psychological and diet perspectives.

3. Health status: covering common associated health issues such as dental problems, infections, infestations and muscle pain.

4. Treatments: including common bitter nail polish, hypnotherapy, punishment, psychotherapy, mineral supplements and medications.

5. Diet: covering amount of milk daily intake and fussy eating of certain food.

6. Other medications/supplements: including Vitamins, Minerals, herbs, over the counter medications and prescribed medications.

7. Co-occurring health issues: covering common health issues that frequently associated with nail biters such as ADHD, bed wetting, oppositional defiant disorder, anxiety disorder, Tourette syndrome, depression, joint pain, psychiatric disorder and others.

8. Social issue: including only yes or no question.

The questionnaires for health practitioners were presented as follow:

1. Profession: includes medical doctors, pharmacist, naturopath and others

2. Possible causes: covering anxiety/nervousness/stress, mineral deficiency, psychological disorders, genetic, poor diet

3. Health status of nail biting children: dental, infections and infestations

4. Co-occurring health disorders: ADHD, enuresis, anxiety, oppositional defiant disorder, Tourette syndrome, depression, jaw joint pain and psychiatric disorder(s).

5. Treatments: bitter nail polish, hypnosis, punishment, psycho-therapy, mineral supplements, medications and others.

6. Experiences of treating nail biting: including yes or no option.

3.3.1.1.7 Questionnaire validity and reliability

The two survey questionnaires had undergone face and construct validation between July 2011 and March 2012. Face validity, an important aspect of an instrument's validity, refers to whether the instrument or measure looks valid to the targeted users (Glesne & Peshkin, 1992). It normally involves judgment on the content, format and general usefulness of the instrument from a personal perspective. In this study, face validity was assessed and established in terms of the presentation and relevance of the questionnaire by two supervisors, two academic

staff members from different professional backgrounds, and the questionnaire trial respondents. The questionnaires were revised at various stages, incorporating the feedback and comments from these experts and target participants.

Construct validity was also assessed, to ensure the questionnaires measured what they set out to measure. Construct validity seeks to establish the relationship between the operational definition of a variable and the true theoretical meaning of a concept (Burns, 2000). In other words, it aims to ensure (Mark, 2003).

3.3.1.2 Questionnaire sample size

The determination of sample size is an important task for the survey research as inappropriate, inadequate, or excessive sample sizes may detrimentally influence the quality and accuracy of the study. This section explains the protocol for determining sample size for the survey questionnaires. Sample size formulas, discussion and common issues in sample size determination are also examined.

The goal of the observational or exploratory research is to collect data that are most representative of a population. The investigators employ information gathered from the survey to generalise findings, within the limits of random error (Holton & Burnett, 1997). The foremost advantage of the survey method is its ability to generalise about a larger group of population by drawing inferences based on a smaller group of people from the survey. That can only be achieved through the use of an appropriate sample and sampling method. The calculation of sample size involved determining population size, confidence interval and confidence level.

The degree of precision is often presented as confidence interval. According to statisticians, the larger a sample size, the more precisely it will represent the target group (Argyrous, 2011). The sample size is the number of required survey respondents. To answer the question of “How many survey respondents do the study needs to accurately represent the study population?” The process was broken down into five steps to calculate the ideal sample size with minimal errors and bias in the survey’s results.

3.3.1.2.1 What is the represented population size?

The target population for this nail biting study included the population of health practitioners, nail-biters and parents of nail-biters. The researchers of this study were unable to determine the exact population. However, mathematical statistics show that population size is only significant when working with a small and known group of people such as the members of an association (Argyrous, 2011). The population of this nail biting study was large and unknown. For this reason, this study ignored the population size in the calculation of sample size.

3.3.1.2.2 How accurate does the study need to be?

Confidence interval, or the margin of error, is a plus-minus figure. For example, 70.0% of the survey respondents agreed to the statement "Nail biting is related to mineral deficiency." If the researcher chose to use a confidence interval of 10.0%, then the researcher can be "sure" that between 60.0% (70-10) and 80.0% (70+10) of the target population would actually have picked that answer. The most commonly used confidence interval is 5%. However, this margin of error could vary between 1-10%.

Confidence level indicates the likelihood how certain researchers can be with the results. In research practices across disciplines, confidence levels are typically stated at 95%. The 95% confidence level indicates that the researcher would get the same results 95% of the time. Other widely used confidence levels range from 90% to 99%. It is not recommended to use confidence level less than 90%. (SurveyMonkey, 2013).

The "Survey Monkey" (SurveyMonkey, 2013) and "Macorr research online" (Research, 2003-2016) websites have sample size calculator software to help calculating the sample size when given the confidence interval, confidence percentage and represented population. To determine the sample size, confidence level (95% or 99%), confidence interval (4, 5, or 10 etc.) and population size should be provided. If the population is unknown or very large, the population box could be left blank. It then automatically calculates the required sample size for the study.

For this nail biting study, the researcher applied the confidence level of 95%, the confidence interval of 10 and unknown population size. With these values, Survey monkey calculator software suggested a sample size of 96.

3.3.1.2.3 What is the response rate of the survey?

The response rate is the percentage of respondents who actually fill out a survey. It is calculated by the number of completed surveys divided by the total number of sent surveys and multiplied by 100. For example, if 30 people fill out a survey out of 200 sent questionnaires, the response rate is (30/200) x 100 = 15%. A rough estimate of the response rate will help to calculate the total number of surveys to be sent out so as to achieve the required sample size.

Many contributing factors affect the response rates. These are the relationship between the researcher and respondents, survey length, complexity, incentives and topic of the survey.

3.3.1.2.4 How many surveys does it need to be sent out?

The number of total survey questionnaires to be sent out can be calculated using the sample size number and the response rate. In this study, the researcher needed to have a sample size of 96 and the estimated response rate was 30%. Therefore, the total number of questionnaires to be sent out to nail biters and parents of nail biters was approximately 290. In relation to questionnaires for health professionals, 85 identified health professionals from medical practice and pharmacies were invited to take part in the study.

3.3.1.3 Questionnaire sampling method

Two basic sampling methodologies in research are probability sampling and nonprobability sampling. The former is a sampling process characterised by random selection, in which all the individuals in the population have equal chances of being selected. The latter involves the selection of samples based on the subjective judgement of the researcher. Nonprobability sampling procedure does not allow for the generalisation of findings on the sample to the entire study population.

However, it is more economical, convenient, and more time effective. If the researcher has no intention to generalise the study findings beyond the sample, the nonprobability procedure can be a better option. For those reasons, nonprobability sampling was used in this present study.

There are three common type of nonprobability sampling, including convenience sampling, quota sampling and judgmental sampling. This study adopted the convenience sampling method because it is suitable for the researchers due to time constraints, finance and the limitations of the study (Fairfax County Department of Neighborhood and Community Services, 2012).

By definition, a convenience sampling procedure involves the selection of respondents to whom the researcher has easy access. In this study, the sampled population were customers at pharmacies, respondents to newspaper advertisements or another type of promotion.

3.3.1.4 Participant recruitment and collection process

A plan was carried out prior to the participant recruitment and data collection stages. These included budgeting for the survey, designing and writing cover letters, marketing and advertising of the survey, thank-you and reminder letters, printing package, building good rapports with third parties who might help to distribute the survey, establishing professional networks, and attending many health seminars in different fields such as for general practitioners, pharmacists, psychologists, naturopaths, nurses and kinesiologists. The aim of this was to maximise the survey exposure to a wider audience within the health industry.

The participant recruitment and collection process were conducted across Tasmania. Given restrictions introduced by the Federal privacy Act 1988 and Tasmania's Personal information and Protection Act 2004, the nail biting survey questionnaire distribution was made after seeking the permission, support, consent and confidentiality from the third party. Third parties such as medical practices, pharmacies, naturopathy clinics, medical associations, pharmacy association, and community health centres were invited to assist with participant recruitment. The

role of these parties was to provide an opportunity for parents of nail biting children, nail biters and health professionals to be directly involved in the survey and interview. Upon their approval, information letters and consent forms were provided to these organisations, along with advertisements, which could be placed on their notice boards. The information letter included information about the aims of the research; nail biting and its potential health risks; and the researchers' contact details.

Newspaper advertisements were also utilised to make the study known to the community. Parents/guardians of potential participants were advised to contact the researchers if they and their child wished to participate. The study also used multiple media strategies, including social networking such as Facebook and Twitter to recruit participants.

A mixture of other techniques was employed to recruit participants including websites, email, mailing list and seminars. The advantages of using websites to recruit participants were its simplicity to implement and no third party costs. The advantages of email and mailing list were targeted recruitment and no third party costs. This mailing and emailing method allowed participants to complete the questionnaires in the privacy of their own home and time, thus minimising social desirability and interview bias.

Two hundred and ninety copies of the questionnaires were printed and distributed out to third parties. An email with electronic link to the survey was sent out to third parties for distribution to their participant network. With the permission of the third party, the printed survey questionnaires were also placed on the tables of each seminar or the reception areas of the practices for volunteer participants to fill out and the survey questionnaires were collected toward the end of each seminar or the drop box at the practice reception. Participants were asked to complete the questionnaire either online or printed copy. Most of the survey collection was through seminars, and emails, hence reply-paid envelopes were sparingly used. Thank you letters were mailed out or emailed to third parties after the survey collection period.

3.3.2 Semi-structured interviews

Three fundamental types of interviews in qualitative research are in-depth unstructured interviews, standardised interviews and semi-structured interviews. Each of them is designed to meet the needs of different studies in terms of certain methodological perspectives, topic issues, the social and contextual elements of the research, and the purpose of the study (Burns, 2000).

The first type of in-depth unstructured interviews is non-directive, in which interview questions are not pre-arranged, but allowed to arise during the conversation (Bowling, 2005; Liamputtong & Ezzy, 2005; Minichiello, Aroni, & Timewell, 2008). This type was not suitable for this study, which had a clear focus and direction as indicated in the research aim and objectives. Secondly, structured or standardised interviews collect data that are coded or quantified for statistical survey. Interviewers usually raise a list of questions with predefined options for participants to choose from (Hansen, 2006). For this type, there is little space for new themes and ideas to emerge during the conversation. This type did not suit the present study as the survey questionnaires already covered those types of questions.

Semi-structured interviews are a hybrid of the other two, where questions direct the respondent to a particular area of discussion with more flexibility. This method allows more probing and opens up the door for better analysis (Bowling, 2005). Specifically, the interviewer raises open-ended questions and is free to ask additional questions to respond to issues or questions raised by the interviewees (Hansen, 2006). Therefore, semi-structured interviews were employed in the study to focus on specific issues surrounding nail biting and to increase the flexibility in exploring further and accommodating the meaning making process of the interviewees. This type of interview allowed the researcher to explore in-depth nail biters' and health professionals' experiences in dealing with nail biting. The results from semi-structured interviews also highlighted problems and issues that were immediate to nail biters, especially in relation to their economical and social challenges.

3.3.2.1 Interview questions

As there were two main groups of interviewees, two interview guides were prepared separately for health professionals and nail biters/parents of nail biters. The process of designing the questions was based on a review of relevant literature and the survey questionnaires to ensure a good match between them. Open ended questions beginning with What, Which, or How were mainly used to probe for meaning-rich responses.

The interview questions and information sheets were pretested among eleven participants from the target population, including three health professionals and eight nail biters/parents of nail biting children. During this process, the participants were asked about the ease of understanding of the questions, the appropriateness of the questions, and comfort level with questions. Thanks to this step, questions that were considered too personal or sensitive could be removed or adjusted. Pretesting of the interviews also assisted the researchers in generating new questions critical to the study focus and determining the appropriate length of the interviews.

The final interview questions are presented below (Appendices 5, 6 and 7).

3.3.2.1.1 Interview questions for nail biters or parents of nail biters

Q1. How did you feel when you see your child biting nails?

Q2. How persistent were you in trying to discourage your child nail biting?

Q3. What did you do when you first notice your child biting their nail?

Q4. Whom did you seek for advises to help your child stop nail biting?

Q5. What advises/treatments have you been recommended?

Q6. What methods that you have tried to stop your child nail biting?

Q7. Which treatment methods do you find effective and which ones are not?

Q8. How is your child's diet?

Q9. What seems to trigger or aggravate your child nail biting?

Q10. What were the most frequent health issues or symptoms have you noticed with your child in the past?

Q11. Any other comments/suggestions you would like to add?

3.3.2.1.2 Interview questions for health professionals

Q1. What is your current understanding of the most probable cause of nail biting in children?

Q2. How would you diagnose nail biting patients?

Q3. Would you carry out any diagnostic test? If so, what tests would you normally use?

Q4. What are you looking for in the analysis tests?

Q5. If a nail biting child comes to see you for treatment, what advice would you give?

Q6. What treatments would you recommend to a nail biting patient?

Q7. If you do not treat the patients, whom would you normally refer the patients to? (e.g., psychiatrists, psychologists)

Q8. What are the experiences do you have with treating nail biting?

Q9. What would be your recommendations to parents of nail biting children and other health professionals on treatment and prevention of nail biting?

Q10. Any other comments / suggestions that you would like to share with us?

3.3.2.2 Interview sampling method

Several sampling methods were adopted in the recruitment of participants for the interview, including convenience sampling, purposive sampling through intermediaries and survey administration, and snowball sampling.

In the former sampling method, interview participants were recruited through survey administration, in which survey participants were asked to indicate whether they were willing to be contacted for a follow-up interview. Among the returned questionnaires, 21 respondents (15 nail biters / parents of nail biters and six health professionals) consented to participate in the follow-up interview. In addition, the third party organisations were also asked to nominate individuals who were then invited by the researcher to participate in the interview.

In the latter sampling method, the participants who gave consent to be interviewed were asked to give referrals to other possible respondents in their network. This method allowed for the identification of certain individuals, networks or groups of sampled individuals that have an association with many other individuals. This is considered an effective sampling method which has been widely used by qualitative researchers (Abramson & Abramson, 1999). With newly identified participants, it was possible to obtain a wealth of meaningful data within the study (Hawthorne, 2007) and to locate more key informants (Kermode & Roberts, 2006; Silverman, 2001) or nail biters within Tasmania. As these respondents either had first-hand experience of nail biting or were professionally and closely cooperating with nail biters, they potentially had reliable information and greater contextual information regarding the fundamental issues and challenges encountered by nail biters.

As a result of these sampling methods, a total of 23 nail biters / parents of nail biting children and 14 health professionals were interviewed.

3.3.2.3 Data collection process

The interviews of health practitioners, nail-biters and parents of nail biting children were conducted either face to face or via the telephone with the options of recording the interviews upon the participants' consent. Audio-recording had the benefit of allowing a greater freedom to listen, interact, focus on the participant, and the opportunity for a thorough and accurate record of the interview. It greatly increased validity "by preserving the authentic data" (Minichiello et al., 2008, p. 117). The face-to-face interviews were conducted at clinics, community health centres, coffee shops or local libraries in Launceston and Hobart city, Australia. Each

location was selected by the participants themselves to provide convenience, comfortable feelings and settings.

The interview time was measured between 15 to 30 minutes each. Audio recordings were used to collect data; and where the participants did not consent to be recorded, interview notes were used. Many of the interviews were face-to-face, which allowed for greater clarification and deeper probing into the questions, resulting in a more in-depth data extraction from the candidates (Bowling, 2005; Liamputtong & Ezzy, 2005; Minichiello et al., 2008). There were two health professionals who were interviewed over the phone, due to the work schedule and unforeseen circumstances of the participants.

3.3.2.4 Trustworthiness and authenticity

Trustworthiness and authenticity were used to evaluate the research measurement and established the rigour of the study from the qualitative perspective.

3.3.2.4.1 Trustworthiness

The trustworthiness of the qualitative data was examined in relation to the three concepts of credibility, transferability and dependability. Firstly, credibility is defined as the extent to which the research findings are credible and truthfully describe the phenomenon being investigated (Hansen, 2006). In other words, it constructs the study rigour through the "confidence in the truth of the findings" (Denzin & Lincoln, 2000, p. 246). In this study, credibility was maintained through the fact that all data were coherently and accurately presented, drawing on the interview notes and transcriptions of recordings. Secondly, the feature of transferability of qualitative findings refers to the match between the study's context and the context to which potential readers can meaningfully transfer the findings (Denzin & Lincoln, 2000; Guba & Lincoln, 2011). Accordingly, transferability was ensured by the researcher in this study with detailed description of the research purposes, research contexts, research instruments and participants and interpretations of the findings. Information related to these elements of the research study was provided to the greatest possible degree for utmost clarity.

Finally, dependability addresses the consistency of the data. According to Denzin and Lincoln (2000), dependability measures the extent to which the research findings can be reproduced or replicated by other researchers (Stake, 1994). In this study, this feature was highlighted by careful documentation of the whole data collection process (including collecting, managing, and processing data), as well as data analysis and interpretation. It was believed that future research could easily replicate this present study thanks to the detailed description of how the study was conducted from the beginning to the end.

3.3.2.4.2 Authenticity

Authenticity is associated with the rigour of data interpretation in research (Denzin & Lincoln, 2000). In this study, the aspects of fairness, ontological authenticity, and catalytic authenticity were carefully considered to ensure authenticity. Firstly, fairness dictates that different value structures and perspectives are honoured within the analysis and interpretation process (Guba & Lincoln, 2011). In the qualitative data analysis of this study, different perceptions, views and experiences of all participants were accurately and fairly presented. Secondly, ontological authenticity refers to how the individual's or group's conscious experience of the world became more informed or sophisticated (Bogdan & Biklen, 2003) while participating in the study. This was achieved through the semi-structured interviews and the information-rich exchanges, whereby the participants had the chance to reflect on and make appropriate assessment of their own experiences regarding nail biting. The third aspect of authenticity is about the extent to which action is motivated (Guba & Lincoln, 2011). This aspect was evident during the interviews when the participants were encouraged to think about how they approached the problem of nail biting, to seek ways to improve their current practices or make recommendations for enhanced nail biting prevention and treatment. Moreover, the qualitative findings led to many practical implications and suggestions for actions, serving as an excellent point of reference for nail biters, parents of nail biting children and health professionals to further reflect on their actions.

3.4 Data management

Data management is an important step prior to data analysis. Good data management facilitates good data analysis by ensuring that no data collected from the respondents are lost or misplaced. It is also to ensure that proper documentation is maintained. Furthermore, it would be beneficial for future analysis with similar parameters to the research. A good data management will ensure that research data are properly stored, retained, documented and made accessible for use and future reuse. The investigators should decide how observational measures are to be identified and what software to be used.

This section covers both quantitative and qualitative data management. Specifically, the data management in the quantitative stage of the study consisted of data entry, data coding, data cleaning, and data archiving.

3.4.1 Quantitative data

To optimise research outcomes, research data were comprehensively documented, retained and stored for use and reuse. Data entry was strictly managed by the researcher, who had been trained intensively in data management skills. The process of data management and archiving data into dedicated repository also adhered to the UTas disposal guidelines. The data from each completed survey were coded according to their category types, allowing for a unique identifier for different response types. Once this categorisation was complete, the data were methodically inputted into the Microsoft Excel for analysis. This data entry process followed a robust guideline to ensure data integrity was maintained throughout the excel workbook with validation tools to ensure invalid entries could not be inputted into the workbook.

3.4.1.1 Data entry

Data entry was managed by importing data gathered from SurveyMonkey into Microsoft Excel and manually entered the paper-based questionnaires into Microsoft Excel. Each returned paper questionnaire was checked for missing data. When there was a missing response to a particular item, ‘best estimation’ was

employed. This method used the estimated common response of the respondents who had similar profession or similar age and health issues to the one who missed the question. For example, if a respondent was a psychologist who missed one of the items of “health related issue with nail biting”, the estimation was generated based on the common response or an average of score of the question from other psychologists with similar professional backgrounds. However, the questionnaires missing values exceeding 10% of the total number of variables were removed from the database. The entered data were then imported from Microsoft Excel into the SPSS 20.0 for data analysis.

3.4.1.2 Data coding

To make sense of the collected data, raw data must be converted into interpretable data (codes) for research analysis. Data coding is a method of classifying, labelling or scoring of research original data into meaningful and relevant data for analysis. Without coding, working with raw data can be very complicated. Data coding helps reduce large quantities of original data into small form of data that can be more accessible and readable by computer software (Bowling, 2005).

The researcher prepared a codebook for the questionnaires prior to data entry. Full ranges of codes were labelled in the codebook against each question. The purpose of this was to ensure that they could later be categorised and filtered against specific answer types. Furthermore, by having a range of codes matching against each question, graphs and charts could be derived from these data to provide a comprehensive snapshot of the findings. For example, children were given a numerical code of 1 while adults were given a numerical code of 2. New codes were given when new variables were created (Guba & Lincoln, 2011). For missing, skipped or inadequate responses, code such as 99 or 999 was applied. By applying adequate coding, these unique identifiers also allowed for a more thorough analysis through segmenting the data, and dissecting particular findings based on question and response types.

3.4.1.3 Data cleaning

Data cleaning is a procedure of making sure that the raw data are valid for a given type of variable. It verifies data and detects any entry discrepancies and erroneous data that may not register with the prescribed coding (Bowling, 2005). A method to ensure that data integrity is adhered to is the use of validation tools on the Microsoft excel workbook. There are various formulas and data matching filters on Microsoft excel that allows for comprehensive data validations. In this study, the researcher used the V lookup function to facilitate the process of identifying duplicate data, matching data and segmenting data.

3.4.1.4 Data archiving

Archiving data is the procedure of retaining and storing data according to the requirements specified in the Codes, archives and records legislation of UTas. The required retention period is dependent upon the content, discipline and type of research data. Generally, the minimum retention period for research data is five years after thesis completion. Research data would be disposed according to UTas disposal guidelines. The data are locked securely to protect against misuse, loss, damage and theft. The research data are stored at UTas Launceston campus.

3.4.2 Qualitative data

3.4.2.1 Transcription of interview data

The recorded semi-structured interviews were transcribed verbatim into Microsoft Word. All transcriptions were checked for accuracy against the audio recordings and entered into NVivo v10.0. The data were then analysed for emerging themes, patterns of behaviours and practices. NVivo v10.0 software (Bowling, 2005) was used to aid data collation and coding as "software for qualitative data analysis can benefit the researcher in terms of speed, consistency, rigor, and access to analytic methods not available by hand" (QRS International, 2012, p. 1214).

3.4.2.2 Data coding

Each interview participant was coded based on information such as being a nail biter, parent of a nail biting child, or health professional. They were then assigned a

numerical code based on the order in which they were interviewed. For example, the third health professional participant would be presented as “HP-3”; the fifth nail biter would be presented as “NB-5”; and the sixth parents of nail biter would be presented as “PNB-6”. Using the auto-coding function of NVivo v10.0, data was then collated based on question headings.

Those participants who provided written responses in the survey questionnaire were similarly assigned a numerical code, such as “HPS-1” or “NBS-5” or “PNBS-7” to ensure anonymity and assist collation of data. Once identified, these responses were copied into the qualitative database using NVivo v10.0 (Weitzman, 1999).

3.5 Data analysis

Data analysis involves the analytical steps and decision rules for interpretation of study findings. These analyses are described as below.

3.5.1 Quantitative data

The quantitative data gathered from the questionnaire were systematically analysed using Excel and SPSS 20.0. This tool allowed the data to be presented in an informative layout, such as providing an organised summary of the respondent data (Calnan, 2007). The other positive aspect from this summary was that it was able to define the descriptive data as “N” and the “n” represent the total number of respondents. Two types of statistical analysis, including descriptive and inferential statistics, were performed to analyse the responses to the questionnaires. Descriptive statistics (including percentages, and frequencies) were used to summarise and organise data. Inferential statistics was used to analyse the data and to draw conclusions from the sample populations (Pallant, 2011; QRS International, 2012). Therefore, the collected data from target participants allow inferences to be made regarding the overall population. As collected data are nominal (categorical), non-parametric tests such as Chi-square ($\chi 2$) test, is appropriate to analyse the collected dataset. Chi-square ($\chi 2$) tests are used to determine if a correlation or association exists between two variables. The basis of a Chi-square test is a comparison of the observed frequencies in each cell and the expected frequencies

or numbers of subjects expected (Munro, 2005). If Chi-square assumptions were violated (i.e., more than 20% of expected cells less than 5), a Fisher's exact test was used. The results are considered to be significant at p-value <= 0.05. The results were tabulated and presented in bar charts and tables.

3.5.2 Qualitative data

In this study, thematic analysis was used to analyse the qualitative data. This method involves thorough examinations, pinpointing patterns and linking them with specific research questions, allowing an easier pathway to categorise the data. Thematic analysis takes the approach of supporting findings with information from the ground theory. It builds on theories that are reinforced in the data themselves (Charmaz, 2006). This is illustrated in thematic analysis largely because the unique process involves interpretation of transcripts, defining and labelling possible themes, evaluate, compare conflicting themes, and construct theoretical models (Guest, MacQueen, & Namey, 2012). One benefit of thematic analysis is that it enables the researcher to define meaningful patterns from the data through the six phases of coding. The phases include consolidating the data, creation of the initial codes, linking for common themes within the codes, evaluating and reviewing the themes, providing definition and labelling the themes and producing an output in the form of a report. Another strength of thematic analysis is that it evaluates the data within the theme and categorises each data in a systematic and organised description and set. The richness of the data allows a clearer view and provides an explicit and implicit assessment of the data. The use of coding for a start provides the key to the data evaluation process, especially when it helps translate the raw data and segregate it into a common theme. The analytics of this data mapping is also unique because it allows the comparison of theme occurrence, frequencies, graphically illustrating the relationship between different themes. Hence the reliance on thematic analysis is essential for researchers because of this outstanding ability to map data set.

Similar to other research methods, the technique to this data analysis can be initiated in two primary ways—inductively or deductively (Braun & Clarke, 2006).

The inductive approach focuses on identifying themes and linking the data based on assumptions that are data-driven (Boyatzis, 1998). This retrospectively constructs the coding without trying to fit the data into a pre-existing model or frame. Essentially this inductive process eliminates the opportunity for researchers to disengage themselves from their theoretical epistemological responsibilities. The second approach is the deductive technique, where it is more theory-driven (Crabtree & Miller, 1999). This method of evaluation is less descriptive since the analysis is restricted to the preconceived frames.

In the current study, thematic analysis involved working through the qualitative data to identify recurrent patterns surrounding the pre-defined themes surrounding the possible causes, related health problems, and treatments of nail biting among nail biters, parents of nail biting children and health professionals. Apart from this deductive approach with pre-defined themes, an inductive approach to thematic analysis was also employed to identify new themes grounded in the data. Through this inductively analytical process, several themes emerged as central to the researched issue of nail biting, including the enablers and barriers to the treatment of nail biting, as well as the needs and expectations regarding of various parties concerning this habitual disorder of nail biting.

3.6 Conclusion

This chapter has presented the methodological framework underlying the design of the study. It has provided a thorough account of the employed mixed methods approach, in which both survey questionnaires and semi-structured interviews were used for data collection. A thorough review of research methodologies was undertaken to establish the credibility of the use of questionnaires and semi-structured in-depth interviews. The chapter has also described in detail the whole procedure taken to conduct the study from preparation of research instruments, through to participant recruitment, data collection, data management and data analysis. The study findings are presented in the following two chapters, chapter 4 and 5, which highlight, compare and generate discussion concerning the experiences, views and challenges of nail-biters, parents of nail biting children and

health practitioners in dealing with nail biting. The findings are analysed and discussed both visually and thematically using a number of noteworthy quotations and graphics in these two chapters.

4 Quantitative Data Analysis

4.1 Introduction

Chapter three introduced and described the research framework and design of the study. While the previous chapter is fundamentally conceptual in the sense that it focuses on the theoretical or conceptual aspects of research methodology, chapter four moves from theory into practice. In other words, it describes the context in which the study was conducted and the process in which quantitative data were collected and analysed. One can expect to see the emerging findings from here. This chapter summarises the results of the data collected from 65 health professionals and 80 nail biters or parents of nail biters and provides a base on which discussion of the results in relation to the research objectives will follow.

4.2 Questionnaire administration

These cross-sectional questionnaires were used to respond to the following research questions (RQs):

> RQ1. What are the views of nail biters and parents of nail biting children in Tasmania, Australia on the possible causes, associated health issues, and treatment of nail biting?
>
> RQ2. What are the views of Australian health professionals on the possible causes, associated health issues, and treatment of nail biting?

The questionnaires explore the views of nail biters, parents of nail biting children and health professionals on nail biting in terms of social, psychological and clinical dimensions which were both descriptive and analytical, using a number of statistical methods. The findings presented in this chapter also include a discussion regarding the characteristics of health professional respondents and nail biters. In addition, the results relating to possible causes of and associated health issues, and possible

treatments of nail biting are reported. The chapter concludes by using inferential statistics to confirm the significance of the findings.

With the permission and support from the third parties (e.g., Pharmacy network, Medical Practices, Schools, Community Health Services etc.), the survey questionnaires for health professionals and nail biters or parents of nail biters were available in hard copies at the reception areas of these places between July – November 2012. These two survey questionnaires were developed from literature search (Baran et al., 2003; Hadley, 1984; Odenrick & Brattstrom, 1985; Pacan et al., 2009; Tanaka et al., 2008; Westling, 1988) and experts in the areas of child health and nail biting, and customised and validated in current study. A drop box was provided in each location for completed questionnaires. Alternative on-line survey delivery was designed and collected by the Survey Monkey (SurveyMonkey, 2013).

A snowball recruitment method was also adopted for maximising the return rate, starting with a few parents of nail biters, nail biters and health professionals of the researcher's professional network who agreed to distribute the information sheets amongst their network of parents, nail biters, and health professionals in Tasmania. This first group of participants would explain the project background and survey process to their networks.

In order to recruit a sample of 96 nail biters and/or parents of nail biters with a 30% anticipated response rate, 290 questionnaires were distributed via third parties. These participants were requested to either fill in the questionnaire on-line or return a completed hardcopy questionnaire either by post using a reply-paid envelope or drop in the drop box at designated locations. Similarly, 85 questionnaires were distributed to health professionals who have experienced or knowledge of treatment of children with nail biting via third parties. The target group of health professionals mainly included medical doctors, pharmacists, naturopaths, kinseologists, and nurses.

At the end of the participant recruitment stages, 80 questionnaires were returned from nail biters and parents of nail biters representing an overall response rate of

28.0%, and 65 questionnaires were returned from health professionals with a response rate of 75.0%.

4.3 Analysis techniques

As discussed in Chapter methodology, the questionnaire data were analysed using SPSS 20.0 (IBM, 2012). Descriptive statistics were used to organise, summarise, analyse and present respondents' data, including proportions and frequencies of collected data (Munro, 2005).

Inferential statistics were used to analyse the data and to draw conclusions from the sample populations (Munro, 2005; Pallant, 2011). Therefore, the collected data from target participants allow inferences to be made regarding the overall population. As the collected data were nominal (categorical), non-parametric tests, such as Chi-square (χ^2) test, were appropriate to analyse the collected dataset. Chi-square (χ^2) tests were used to determine if a correlation or association existed between two variables. The basis of a Chi-square test is a comparison of the observed frequencies in each cell and the expected frequencies or numbers of subjects expected (Munro, 2005). If Chi-square assumptions were violated (i.e., more than 20.0% of expected cells less than 5), a Fisher's exact test was used. The results were considered to be significant at p-value <= 0.05.

4.4 Profile of the participants

The questionnaire respondents provided basic information regarding their characteristics and backgrounds which are highlighted in details below.

4.4.1 Characteristics of health professionals

As indicated in Table 4.1, the majority of the respondents were pharmacists (31.0%), followed by medical doctors (26.0%), and naturopaths (9.0%). Seventeen per cent of other professions included in the sample were psychologist, kinesiologist, oral health therapist, dentist, and hypnotherapist.

Table 4-1: ***Characteristics of health professionals (N=65)***

Health professionals	**n (%)**
Homeopath	4 (6)
Medical doctor	17 (26)
Naturopath	6 (9)
Nurse	4 (6)
Nutritionist	4 (6)
Pharmacist	20 (31)
Others	10 (17)
Total	65 (100)

4.4.2 Characteristics of nail biters

As reported in the Table 4.2, from the information provided by 80 participating nail biters (N_{nb} = 45) and parents of nail biting children (N_{pnb} = 35), 54.0% of the surveyed nail biters were less than 18 years old and 46.0% were 18 years of age and over. Parents of nail biting children hereafter referred to as the 'surveyed nail biters' as parents were supposed to respond on behalf of their nail biting children.

Regarding nail biting status, slightly more than half (56.0%) of them were currently suffering nail biting, whereas 44.0% claimed that their nail biting habits had ceased.

The results also indicated that nail biting predominantly emerged at a very early stage, with the vast majority of 96.0% of the nail biters reportedly commencing this habit during childhood. Only 4.0% of the nail biters started their nail biting during their teenage years.

In relation to frequency of nail biting, 81.0% of the participants reported they bit their nails over three times a day, 11.0% of them bit their nail one to three times a day. Only a small percentage of participants (8.0%) reported they sometimes bit their nails.

Table 4-2: ***Characteristics of nail biters (N=80)***

Characteristics	n (%)
Age groups	
- **Less than 18 yrs**	43 (54)
- **18yrs and over**	37 (46)
Nail biting status	
- **Past**	35 (44)
- **Current**	45 (56)
Commencement of nail biting	
- **Childhood**	77 (96)
- **Teenage hood**	3 (4)
Frequency of nail biting	
- **Sometimes**	6 (8)
- **1 to 3 times a day**	9 (11)
- **Over 3 times a day**	65 (81)

4.5 Nail biters' perspective

The data collected from the survey provided a general understanding about the nail biters and parents of nail biting children regarding their perceived causes of nail biting, associated health issues, and possible treatments of nail biting. The findings are thematically presented in the following sub-sections.

4.5.1 Possible causes of nail biting

The participating nail biters and parents of nail biting children were asked about their understanding of the most common cause of nail biting. The results showed that psychological imbalances, such as anxiety, nervousness, or stress, were believed by the largest proportion of the respondents (48.0%) to mainly lead to the development of nail biting habit. Nail biting was also attributed to other factors as the most common cause, including mineral deficiency (38.0%), poor diet (36.0%), and psychological disorders (15.0%). Further statistical details pertaining to their perceived causes of nail biting are as follows.

4.5.1.1 Psychological imbalances (Anxiety, nervousness or stress)

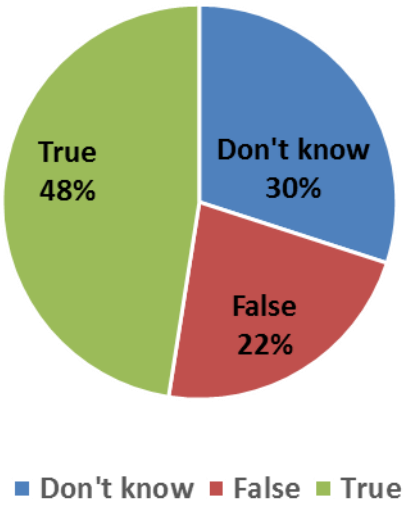

***Figure 4-1*: Anxiety or nervousness or stress (N=80)**

The survey questioned if the nail biters or parents of nail biting children believed that psychological conditions such as anxiety, nervousness or stress were the principle cause of nail biting condition. The data analysis (Figure 4.1) showed that nearly half (48.0%) of the respondents confirming this belief. On the other hand, about one third (30.0%) of the respondents indicated that nail biting habit was not related to psychological conditions. A smaller percentage of the respondents (22.0%) did not know if their nail biting habit was triggered by these imbalances in one's psychology.

4.5.1.2 Mineral deficiency (e.g., calcium, iron, magnesium, potassium phosphate)

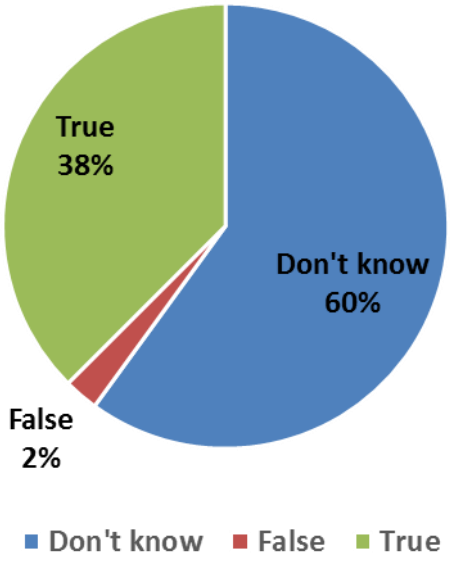

***Figure 4-2*: Mineral deficiency (N=80)**

As indicated in Figure 4-2, out of the surveyed 80 nail biters and parents of nail biting children, 38.0% believed that mineral deficiency was the primary cause of nail biting. While the majority (60.0%) were not sure if there was any causal relationship between mineral deficiency and nail biting, only 2.0% rejected this relationship.

4.5.1.3 Psychological disorders

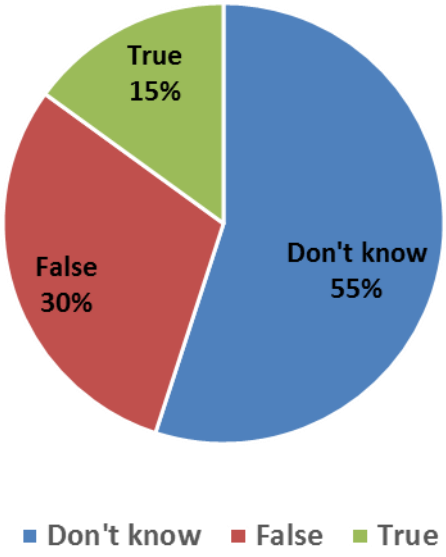

***Figure 4-3*: Psychological disorders (N=80)**

Concerning psychological disorders, the results (Figure 4-3) indicated that only a small percentage of the respondents (15.0%) believed that psychological disorders were the main trigger for nail biting. By contrast, thirty per cent of the surveyed group disagreed that psychological disorders were primarily responsible for nail biting. More than half of the remaining respondents (55.0%) did not know if there was any association between nail biting and psychological disorders.

4.5.1.4 Poor diet

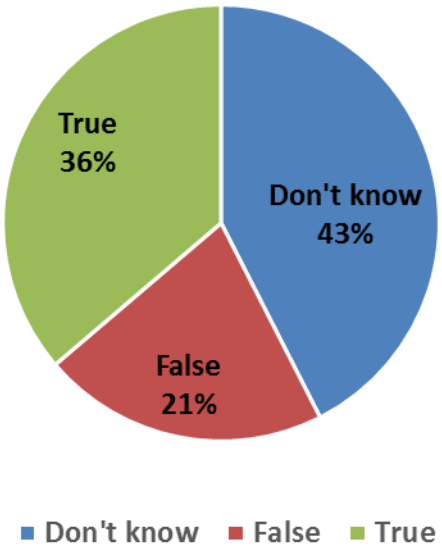

***Figure 4-4*: Poor diet (N=80)**

The survey also sought to establish if poor diet was perceived by nail biters and parents of nail biting children as the primary cause of nail biting. Among the 80 respondents, 36.0% agreed that poor diet was the main of nail biting, while a smaller percentage of 21.0% disagreed with this. The remaining 43.0% did not know if there was any link between poor diets and nail biting associated health issues (Figure 4-4).

4.5.2 Associated issues

Apart from the perceived causes of nail biting, nail biters and parents of nail biting children were asked to indicate any associated health, dietary and social issues in the past 12 months.

4.5.2.1 Self-reported health issues

Details related to self-reported health issues in both frequencies and percentages can be found in Table 4.3.

Table 4-3: ***Associated health issues in the past 12 months (N=80)***

		Yes		No		Don't know		Total
		n	**%**	n	%	**n**	%	**N**
a.	**Dental problems (gum infection, gum bleeding, toothache, worn teeth, crack tooth enamel, teeth falling out)**	**34**	43%	**46**	58%	**0**	0%	**80**
b.	**Diarrhoea**	**22**	28%	**53**	66%	**5**	6%	**80**
c.	**Poor diet**	**20**	25%	**59**	74%	**1**	1%	**80**
d.	**Muscle cramps**	**33**	41%	**41**	51%	**6**	8%	**80**
e.	**Eye infection**	**11**	14%	**66**	83%	**3**	4%	**80**
f.	**Inflammation of skin around the nails**	**42**	53%	**36**	45%	**2**	3%	**80**
g.	**Parasites/worms**	**22**	28%	**47**	59%	**11**	14%	**80**
h.	**Infections**	**41**	51%	**35**	44%	**4**	5%	**80**
i.	**Cold and flu**	**57**	71%	**21**	26%	**2**	3%	**80**
j.	**Fungal infection**	**20**	25%	**55**	69%	**5**	6%	**80**
k.	**Cold sores**	**10**	13%	**68**	85%	**2**	3%	**80**

Some interesting results were revealed by the figures. The most notable was the high percentage of nail biters who had cold and flu as the most common past health issue (71.0%), higher than the national average rate of Australians who had cold and flu (62.0%) (Department of Health, 2015).

The other common past issues identified include inflamation (53.0%), infections (51.0%), dental issues (43.0%), and muscle cramps (41.0%).

On the other hand, the least common past health issues were cold sores (13.0%), eye infection (14.0%), poor diet (25.0%), diarrhoea (28.0%), and fungal infection (25.0%). There was a small percentage of respondents who were not sure what past health issues they had.

4.5.2.2 Health issues diagnosed by doctors

The survey respondents also identified some clinical problems of nail biters as diagnosed by doctors.

Table 4-4: *Health issues diagnosed*

		Yes		No		Don't know		Total
		n	**n**	n	%	**n**	%	**n**
a.	**Attention deficit hyperactivity disorder (ADHD)**	**5**	6%	**73**	91%	**2**	3%	**80**
b.	**Enuresis (Bed wetting)**	**3**	4%	**75**	94%	**2**	3%	**80**
c.	**Oppositional defiant disorder**	**2**	3%	**75**	94%	**3**	4%	**80**
d.	**Anxiety disorder**	**15**	19%	**59**	74%	**6**	8%	**80**
e.	**Tourette syndrome**	**2**	3%	**78**	98%	**0**	0%	**80**
f.	**Depression**	**12**	15%	**68**	85%	**0**	0%	**80**
g.	**Joint pain**	**16**	20%	**62**	78%	**2**	3%	**80**
h.	**Psychiatric disorder**	**4**	5%	**76**	95%	**0**	0%	**80**
i.	**Other health issues (e.g., sleeping difficulty, kidney problem etc.)**	**37**	46%	**43**	54%	**0**	0%	**80**

It was found that the most commonly diagnosed health problems were in the category of other health issues, including sleeping difficulty, kidney problem, etc. Specifically, nearly half (46.0%) of the respondents reported those problems. Joint pain, depression, and anxiety disorder ranked second, third, and forth with 20.0%, 19.0%, and 15.0% of the surveyed nail biters being diagnosed by the doctor. Other less frequent diagnosed problems were attention deficit hyperactivity disorder (6.0%), psychiatric disorder (5.0%), bed wetting (4.0%), oppositional defiant disorder (3.0%) and Tourette syndrome (3.0%).

4.5.2.3 Diet-related issues

To identify any health issues that may have a link to nutrition intake, questions related to nail biters' diet were included in the survey. Those issues covered milk intake, food refusal, and the use of supplements or medications.

Table 4.5 below demonstrated the reported level of daily milk intake among the survey nail biters.

Table 4-5: ***Daily milk intake***

Milk (ml)	Total (N)	Percentage
0	18	23%
25	1	1%
50	2	3%
75	3	4%
100	7	9%
200	4	5%
250	16	20%
275	1	1%
300	1	1%
375	8	10%
400	5	6%
500	13	16%
775	1	1%
Total	**80**	

The analysis result showed that 23.0% of the surveyed nail biters did not consume any milk on a daily basis. About one fifth (20.0%) of the nail biters reported to drink 250ml a day and 16% drank 500ml of milk a day. Only 1.0% of the respondent drink 775ml of milk a day.

The overall picture illustrated that nearly half (45.0%) of the group drank less than 250ml of milk a day and 55.0% drank between 250ml to 775ml of milk a day. Most Australians consume only about half the recommended quantity of milk products or alternatives. The minimum recommended amount of milk and/or alternatives ranges from 1.5 - 2 serves a day for children up to 8 years old to 2.5 – 3.5 serves a day for older children and adolescents; 2.5 serves a day for younger adults, and from 3.5 - 4 serves a day for older adults. One standard serve of milk is equivalent to 250ml (NHMRC, 2013).

Concerning their diet, a proportion of the surveyed nail biters were reported to be fussy with food, refusing to eat certain types considered to be necessary by health professionals.

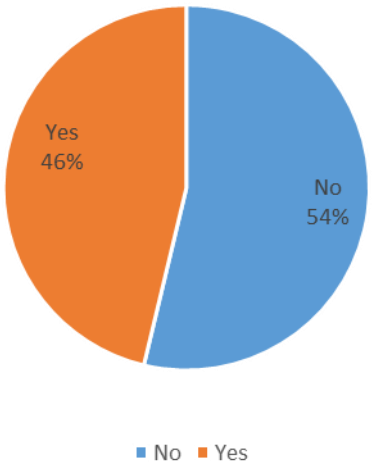

***Figure 4-5*: Fussy with food**

Specifically, the result showed that 46.0% of the surveyed nail biters were fussy eaters. This figure demonstrated higher fussy eating incidence compared to the results indicated in an Australian study conducted in Brisbane which indicated that 28.0% of 2-4 years old children were fussy eaters, reported by their parents involved in the study (McDermott et al., 2008).

Table 4.6 provides further details on the food types that the nail biters under study refused to eat.

Table 4-6: *Food combination that you/ your child refuse(s) to eat*

Food combination	Total	Percentage
Lamb combination	2	3%
Meat	17	21%
Vegetables	9	11%
Fruits	5	6%
No response	37	46%
Milk/dairy products	10	13%
TOTAL	80	100%

The result from the survey illustrated a few combinations of food that the nail biters did not like, and thus refused to include them in their diet. The most unpopular food in the group was meat and lamb combination, which was refused by 24.0% of the participants. Milk and dairy products were not favourable among 13.0%, and vegetables, including spinach, zucchini, broccoli etc., were not the choice of 11.0% of the surveyed nail biters.

Nearly half of the nail biters (46.0%) did not respond to the question. There were a smaller percentage of the nail biters who did not like fruits (6.0%), and thus tended to exclude them from their nutrition intake.

4.5.2.4 Current medications/supplements

To obtain a more complete picture of the nutrition intake and other health issues of the surveyed nail biters, a question related to current supplements (e.g. vitamins, minerals, herbs, multivitamins, etc.) and mediations was included in the survey. The findings to this question are presented in Figure 4.9 below.

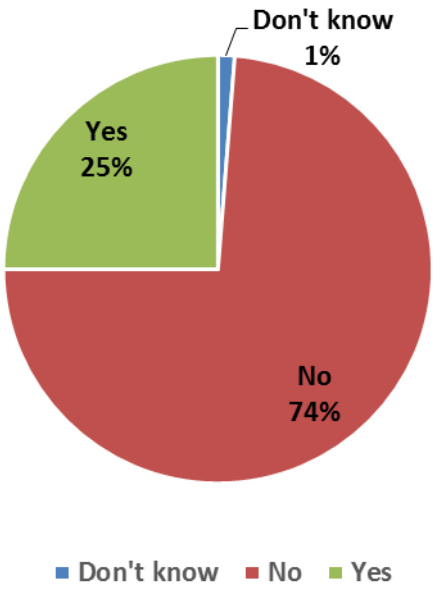

***Figure 4-6*: Medication or mineral supplement used**

As can be seen, the survey result showed that about one fourth (25.0%) of the respondents reported to currently use medication or supplement intake. Figure

4.10 provide details about the types of medications or supplements used by the nail biters.

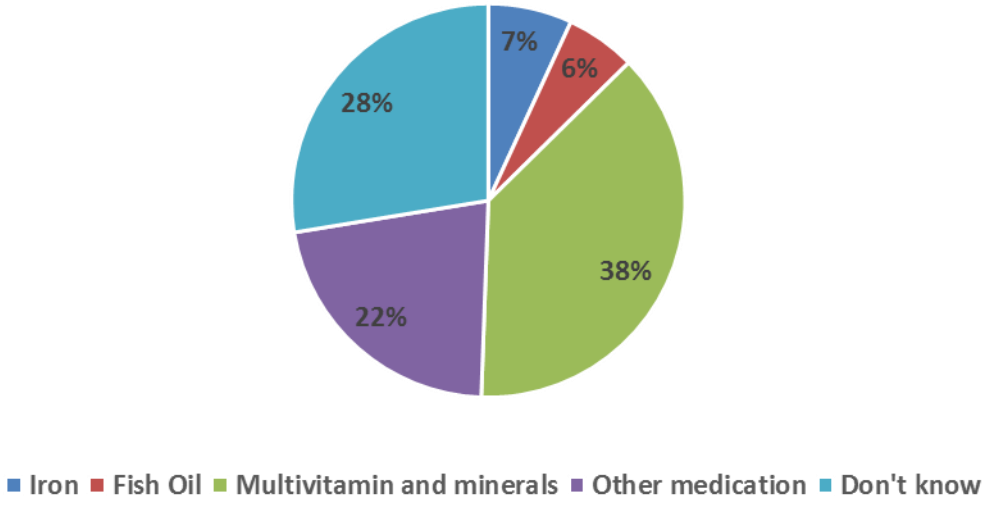

Figure 4-7: **Types of medication or supplement used**

The results showed a few distinctive groups of supplements and medications used by the nail biters. The highest proportion of the nail biters (38.0%) reported using multivitamin and minerals. This group included fish oil, vitamin D, vitamin C, zinc, magnesium, tissue salts and multivitamins. Another group of 22.0% of the respondents noted they used different medication, such as Xanax, Lipitor, Ritalin and Zoloft. A small percentage of the group (6.0%) resorted to a combination of fish oil and vitamin, and 7.0% used iron supplements along with other multivitamins. The remaining of 28.0% of the respondents did not know what medication or supplement they used.

4.5.2.5 Social issue

The survey also sought to find out whether nail biters had any social issues.

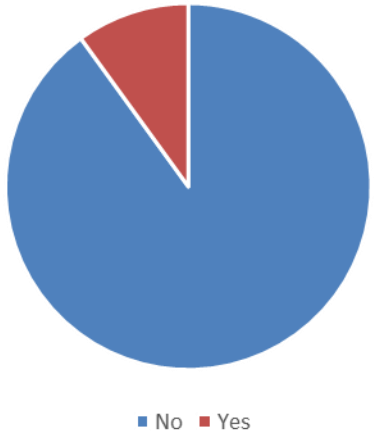

***Figure 4-8*: Social issues**

From the analysis result as shown on Figure 4.11, it was revealed that 90.0% of nail biters did not have any social issue, and 10.0% reported having certain social issues such as bullying, family welfare, isolation, peer rejection, etc.

4.5.3 Possible treatments

The third primary issue of interest in the survey was related to the treatment of nail biting from the experiences of the surveyed nail biters. The findings related to their past treatments are presented in Table 4.7 below.

Table 4-7: *Types of treatment received (N=80)*

		Yes		No		Total
		n	%	n	%	N
a.	Bitter nail polish	42	53%	38	48%	80
b.	Hypnosis	7	9%	73	91%	80
c.	Punishment	24	30%	56	70%	80
d.	Psychotherapy	9	11%	71	89%	80
e.	Mineral supplements	27	34%	53	66%	80
f.	Medication	9	11%	71	89%	80
g.	Other treatments	11	14%	68	86%	79

The findings from the survey showed that the most widely used treatment for nail biting was the use of bitter nail polish (53.0%), followed by mineral supplements (34.0%) and punishment (30.0%). Medication and other psychotherapies were reported to be used by the same proportion of 11.0%. A slightly smaller proportion of 9% employed hypnosis treatment for nail biting. About 14.0% of the respondents mentioned other treatments, which included the use of fake nails, oroxine, pedisure formula, ceasing drinking coffee, will power, and gluten free diet.

The respondents were asked if they knew the details of the mineral supplements used to treat their nail biting condition. Only 27 (34.0%) respondents confirmed and provided details on mineral supplements used for nail biting treatment. Details of these mineral supplements are provided in Table 4-8. It was revealed that the most commonly used supplements were calcium, magnesium, vitamin D, multivitamin and iron.

Table 4-8: ***Details of mineral supplements***

Mineral details	n
Calcium phosphate, Calc Fluor, Magnesium phosphate & Silica	2
Calcium, Magnesium, STS Combi 5, Iron, Vitamin D	1
Diatomaceous Earth	2
Iron	2
Iron and multivitamin	1
Iron supplement (Floradix)	1
Iron supplement (Increment)	1
Iron, Zinc, Blackmores Hair, skin and nails.	1
Iron, Zinc, Mega Magnesium, STS combi 5	1
Multivitamin, B-complex, Vitamin D	2
Prenatal Multivitamins & Mineral (Elevit)	1
Schuessler Tissue Salts (STS) Kidz Be Calm and Kidz Strong Bones and Teeth	1
STS Kidz Strong bones and teeth, Vitamin D, Proform formula.	1
STS Be Calm, Magnesium Plus, Calcium, multi-Vitamins	1
STS Kidz Be Calm, STS combi K, Magnesium, Floradix	1
STS Kidz Health1 appetite, Be Calm; Calcium + D.	1
STS Nat Mur, Silica, Calcium, Magnesium	1
Vitamin D, BM Celloid Silica and CPMP	1
Vital Greens (organic multiVitamins & Minerals)	1
Vitamin B3, Mega Magnesium, Vitamin D, Schuessler Tissue Salts Combi 5, Endep	1
Vitamin D and Calcium	1
Vitamin D, Blackmore Celloid CP and PMP	1
ZINC, BM Celloid CP and PMP	1
Total	27

The survey respondents were further asked to indicate the treatment methods that they found to be most effective based on their first-hand user experience. The findings to this question can be found in Figure 4.13 below.

***Figure 4-9*: Possible effective treatments**

The results indicated that the nail biters tended to use combination of treatments rather than any single treatment. In addition, it was found that bitter nail polish was thought to be effective by 39.0% of the nail biters. More than one fifth (22.0%) considered punishment combination as effective for nail biting, and 8.0% mentioned psychotherapy.

4.6 Health professionals' perspective

In addition to the perspective of nail biters and parents of nail biting children, the survey sought to examine the perspective of health professionals regarding the perceived causes of nail biting, associated health issues, and possible treatment of nail biting. The findings are presented in the following sub-sections.

4.6.1 Possible causes of nail biting

The health professionals were firstly asked to indicate their opinions about the most probable cause of nail biting. Table 4.9 provides detailed statistics on their responses to this question.

Table 4-9: ***Health professionals' views on possible causes of nail biting (N=65)***

	Don't know		False		True		Total
	n	%	n	%	n	%	N
a. Anxiety	5	8%	5	8%	55	85%	65
b. Mineral deficiency	20	31%	13	20%	32	49%	65
c. Psychological disorders	15	23%	15	23%	35	54%	65
d. Genetics	26	40%	18	28%	21	32%	65
e. Poor diet	17	26%	15	23%	33	51%	65

The results showed that the surveyed health professionals strongly believed the main possible cause of nail biting was psychological imbalances, such as anxiety, nervousness and stress. Specifically, a high proportion of 85.0% of the health professional respondents principally attributed nail biting to psychological imbalances.

Psychological disorder and poor diet came second and third in the list of main causes, being mentioned by more than a half of the health professionals. To be more specific, 54.0% and 51.0% believed psychological disorder and poor diet to be mainly responsible for nail biting respectively. About one fourth were not so sure about this relationship.

Mineral deficiency came fourth in the list of perceived causes of nail biting, with nearly half (49.0%) believing that it had a causal relationship with nail biting. The other 20.0% of the respondents believed that mineral deficiency does not relate to nail biting while the remaining 31.0% did not know if there was any correlation between the lack of mineral and nail biting.

Genetic disorder was cited by 32.0% of the respondents to be the main cause of nail biting. While 28.0% did not reject the link between genetic disorders with nail biting, 40.0% were not sure about the association between them.

The results from the follow-up open-ended question indicated that the health professionals believed that there were many other contributing causative factors to nail biting. The factors mentioned by 31 responses to this question are presented below.

- Thyroid disorders such as hypothyroidism and iodine deficiency;
- Gluten intolerance;
- Poor absorption of nutrients and malabsorption disorders;
- Vitamin D deficiency;
- Food sensitivity;
- Parasites;
- Fungal infection;
- Over vaccination;
- A child's force of habit and natural curiosity that has led to this habit;
- Boredom, stimulation;
- Self –soothing;
- Oral fixation;
- Perfectionism;
- Laziness- don’t have nail clipper nearby;
- Problems in the childhood;
- Curiosity; and
- Imitation.

4.6.2 Associated health issues

Apart from their views regarding possible causes of nail biting, the health professionals were asked to report on the associated health issues that were experienced by their nail biting patients in the past 5 years. The results related to this question are presented in Table 4.10.

Table 4-10: ***Health issues of nail biting patients in the last 5 years (N=65)***

	Don't know		No		Yes		Total
	n	%	n	%	n	%	N
a. Gingivitis	27	42%	13	20%	25	38%	65
b. Diarrhoea	30	46%	16	25%	19	29%	65
c. Parasites/worms	15	23%	11	17%	39	60%	65
d. Frequent bacterial/viral infections	24	37%	11	17%	30	46%	65
e. Fungal infections	30	46%	14	22%	21	32%	65

It was found that the most prevalent health issue among nail biter patients was the existence of parasites/worms, which was reported by 60.0% of the health professionals. A Finnish survey conducted to examine the occurrence of intestinal parasites in 726 hospital patients, 175 healthy adults and 212 children, and 976 healthy Finnish holiday-makers prior to their trip abroad. Further, 344 children were tested for *Enterobius vermicularis* (pin worms). The total prevalence of intestinal parasites in the hospital patients was 4.2%, and that of pathogenic parasites 2.9%. The prevalence rates in healthy subjects were 4.9% and 1.5%, respectively. A test for *Enterobius vermicularis* was positive in 5.2% of children examined (Kyrönseppä, 1993). Bacterial/viral infections were also very popular, with nearly half (46.0%) of the health professionals reporting to diagnose them among their nail biting patients. Other health problems were gingivitis (38.0%), fungal infections (32.0%), and diarrhoea (29.0%). More statistical details regarding each health problem are presented below.

The above results highlighted a few different views between the health professionals. For a start, 38.0% of the health professionals had nail biting patients who experienced gingivitis in the past 5 years, while the other 42.0% did not know if their nail biting patients suffered gingivitis. The remaining 20.0% of the health professionals believed that gingivitis had no connection with nail biting.

As for the findings under the diarrhoea category, nearly half of the health professionals (46.0%) did not know if their nail biting patients had diarrhoea in the

past five years. Only 29.0% of health professional noticed that their nail biting patients suffered diarrhoea and 25.0% reported no cases of diarrhoea.

The final result from the survey revealed that 60% of the health professionals reported their nail biting patients had parasites or worm infestations in the past five years, while 25.0% were not sure and 17.0% believed that there were no cases of worm/parasite infestation among their patients.

The result also revealed that 46.0% of the health professionals were aware that their nail biting patients had frequent bacterial and viral infections. On the other hand, 37.0% did not know if there was any case and the remaining 17.0% reported no cases of bacterial/viral infections.

Regarding fungal infections, the result illustrated that 32.0% of the health reported their nail biting patients suffering from infections. However, nearly half of them (46.0%) did not know for sure and the rest (22.0%) thought that their patients did not suffer from fungal infections.

The health professionals also reported other health issues experienced by their nail biting patients as below:

- Inflammation and bleeding skin around nail beds;
- Skin peeling off;
- Dermatitis;
- Muscle pain, neck stiffness;
- Sleep problems;
- Stomach bloating and pain;
- Constipation;
- Poor concentration;

- Fatigue;
- Teeth grinding; and
- Personal issues.

The findings related to other health disorders of nail biting patients are outlined in Table 4.11.

Table 4-11: ***Reported health disorders of nail biting patients (N=65)***

Health disorders	Don't know		No		Yes		Total
	n	%	n	%			
a. Attention deficit hyperactivity disorder (ADHD)	18	28%	15	23%	32	49%	65
b. Enuresis (bed wetting)	16	25%	16	25%	33	51%	65
c. Opposition defiant disorder	30	46%	11	17%	24	37%	65
d. Anxiety disorder	10	**15%**	8	**12%**	47	**72%**	65
e. Tourette syndrome	34	52%	17	26%	14	22%	65
f. Depression	27	42%	8	12%	30	46%	65
g. Jaw joint pain	29	45%	13	20%	23	35%	65
h. Psychiatric disorder(s)	33	52%	10	16%	21	33%	64

Among the eight listed health disorders, it was worth noting that anxiety disorder was the most prevalent problem of nail biters, which was reported by 72.0% of the participating health professionals. Bed wetting (51.0%) and attention deficit hyperactivity disorder (49.0%) ranked second and third, followed by depression (46.0%). Opposition defiant disorder, jaw joint pain, psychiatric disorders, and Tourette syndrome were also reported by 37.0%, 35.0%, 33.0%, and 22.0% respectively. However, the actual prevalence of these eight health problems could be higher because many health professionals were not sure if their nail biting patients suffered from certain health issues or not. In the follow-up question, they mentioned a few other health disorders which were not listed in the survey. Those included Celiac, IBS, ulcer colitis, Crohn's disease, GORD, eye twitching, nocturnal

teeth grinding, hypothyroidism, anorexia, impulse control problem, and iodine deficiency.

4.6.3 Recommended treatments for nail biting

In addition to possible causes and associated health issues, the participating health professionals were asked about their recommended treatment methods for nail biting. Table 4.12 below clearly present the findings.

Table 4-12: ***Recommended treatments for nail biting patients (N=65)***

	No		Yes		Total
	n	%	n	%	
a. Bitter nail polish	13	20%	52	80%	65
b. Hypnosis	44	69%	20	31%	64
c. Punishment	63	98%	1	2%	64
d. Psychotherapy	40	63%	24	38%	64
e. Mineral supplements	38	58%	27	42%	65
f. Medication	58	89%	7	11%	65
g. Others	44	68%	21	32%	65

The results indicated that a very large proportion of the health professionals (80%) would recommend the use of bitter nail polish as a treatment method for nail biting. Nearly half of them (42.0%) suggested the use of mineral supplements and a smaller proportion were in favour of psychotherapy (38.0%) and hypnosis (31.0%). Medication and punishment were found to be unpopular treatment methods among the participating health professionals, recommended by only 11.0% and 2.0% respectively.

Regarding the recommended mineral supplements to nail biting patients, the health professionals listed some highly recommended as presented in Table 4.13.

Table 4-13: ***Recommended mineral supplements to nail biting patients***

	n (%)
Calcium	18 (72)
Magnesium	16 (64)
Silica	12 (48)
Iron	5 (20)
Schuessler Potassium Phosphate (Kali phos)	5 (20)
Zinc	2 (12)
B-complex	2 (8)
MultiVitamins and minerals	2 (8)
Vitamin D	2 (8)
Iodine	1 (25)

The findings indicated that Calcium was the most frequently (72%) recommended mineral by the health professionals. Other frequently recommended minerals were Magnesium (64.0%), Silica (48.0%), Iron (20.0%), Schuessler Potassium Phosphate (20%) in the form of Tissue Salts or Celloid, and Zinc 12.0%. Other less commonly recommended supplements were Multivitamins and minerals, Multi B-complex, Vitamin D and Iodine.

In terms of medication, the health professionals recommended the following medications (Table 4-14):

Table 4-14: ***Recommended medication for nail biting treatment***

Medication description	n
CPMP or PPMP Celloids	1
SSRI	3
SSRI, Anti-helminths	1
Thyroid medications	1
Zoloft, Endep, Aropax	1
TOTAL	7

The outcome of the survey indicated that some health practitioners suggested the use of antidepressant / anti-anxiety drugs such as SSRI (Serotonin reuptake inhibitor), Zoloft, Aropax, and Endep to manage nail biting. Some health

professionals recommended using anti-helminths in parasites infested patients and thyroid medications in thyroid disorder patients.

In relation to other treatment methods, most of the health professionals mentioned the development of a balanced diet to ensure adequate nutrition intake. The addition of milk or diet rich magnesium, for example, was frequently mentioned. Other methods the health practitioners also recommended to nail-biters were to get off all cow milk products or all gluten products; take probiotics; find out worries/ concerns that trigger nail biting and assist with process of seeking solutions; use strategies to manage stress/anxiety; drink nutritional formula such as Proform which contains all essential amino acids, carbohydrate, vitamins and minerals; use oral devices; or use rubber band as a punishment method to stop nail biting. Another health professional suggested "Substitution" method such as chew on lollies, vegies, carrot, or squeeze a stress ball instead of biting nails. Other techniques such as visualisation, relaxation technique and will power were also thought to be helpful to stop nail biting. For example, one health professional suggested using flower remedies (such as walnut and chestnut bud) to break the habit of nail biting, which needed to use in conjunction with mineral supplements.

4.7 Different views on nail biting treatment, causes and related health issues

The above descriptive statistics section has demonstrated and highlighted health professionals', parents of nail biters' and nail biters' characteristics and their responses about possible causes, associated health issues and recommended treatment. This section explores the data (mostly categorical or nominal data), using Chi-square ($\chi 2$) tests, to discover possible correlations between various variables in the study, for example between health professions and methods of nail biting treatments, between frequency of nail biting and health issues, or dietary etc.

It should be noted that only those tests that were indicated to be significant are discussed in detail below.

4.7.1 Different professional views on nail biting treatment

4.7.1.1 Bitter nail polish

In Table 4-15, in total, 52 health professionals (80% of the total) supported using bitter nail polish for nail biting treatment; and of these, 17 were medical doctors (32.7%), 20 pharmacists (38.5%), three naturopaths (5.8%), and 12 other health professionals (23.1%). The data analysis showed that there was a significant association between health professions and views about whether or not bitter nail polish would be used for nail biting treatment (Fisher's Exact Test = 21.604; p-value = 0.00 < 0.05).

Table 4-15: ***Different professional views on using bitter nail polish for nail biting treatment (N=65)***

	Health professions	Yes	No	Total
Medical Doctor	Count	17	0	17
	Expected Count	13.6	3.4	17.0
	% within Health professionals	100%	0%	100%
	% within Bitter nail polish treatment	32.7%	0.0%	26.2%
	% of Total	26.2%	0.0%	26.2%
Pharmacist	Count	20	0	20
	Expected Count	16	4	20
	% within Health professionals	100%	0%	100%
	% within Bitter nail polish treatment	38.5%	0%	30.8%
	% of Total	30.8%	0%	30.8%
Naturopath	Count	3	2	5
	Expected Count	4.0	1.0	5.0
	% within Health professionals	60%	40%	100%
	% within Bitter nail polish treatment	5.8%	15.4%	7.7%
	% of Total	4.6%	3.1%	7.7%
Others	Count	12	11	23
	Expected Count	18.4	4.6	23.0
	% within Health professionals	52.2%	47.8%	100%
	% within Bitter nail polish treatment	23.1%	84.6%	35.4%
	% of Total	18.5%	16.9%	35.4%
Total	Count	52	13	65
	Expected Count	52	13	65
	% within Health professionals	80.0%	20%	100%
	% within Bitter nail polish treatment	100%	100%	100%
	% of Total	80.%	20.0%	100%

Fisher's Exact test = 21.604; p-value = 0.00 < 0.05.

Follow-up Chi Square tests were conducted to each pair of health professional groups to examine whether bitter nail polish was a favourable treatment for nail biting from the health professional participants. The analysis result indicated that bitter nail polish was significantly favourable for nail biting treatment by medical doctors compared to naturopaths (Fisher's Exact test = 7.48; p-value = 0.043 <

0.05); and others health professional group (Fisher's Exact test = 11.214; p-value = 0.001 < 0.05). Pharmacists also agreed that bitter nail polish was a preferable treatment for nail biting compared to naturopaths (Fisher's Exact test = 8.665; p-value = 0.004 < 0.05) and other health professional group (Fisher's Exact test = 12.853; p-value = 0.00 < 0.05).

4.7.1.2 Hypnosis

In Table 4-16, in total, 45 health professionals (69.2% of the total) did not recommended the use of hypnosis for nail biting treatment; and of these, 12 were medical doctors (26.7%), 18 pharmacists (38.5%), four naturopaths (8.9%), and 11 other health professionals (24.4%). The data analysis showed that there was a significant association between health professions and views about whether or not hypnosis would be a preferable treatment for nail biting (Fisher's Exact Test = 9.084; p-value = 0.021 < 0.05).

Table 4-16: ***Different professional views on using hypnosis for nail biting treatment (N=65)***

	Health professions	Yes	No	Total
Medical Doctor	Count	5	12	17
	Expected Count	5.2	11.8	17.0
	% within Health professionals	29.4%	70.6%	100%
	% within Hypnosis treatment	25%	26.7%	26.2%
	% of Total	7.7%	18.5%	26.2%
Pharmacist	Count	2	18	20
	Expected Count	6.2	13.8	20.0
	% within Health professionals	10%	90%	100%
	% within Hypnosis treatment	10%	40%	30.8%
	% of Total	3.1%	27.7%	30.8%
Naturopath	Count	1	4	5
	Expected Count	1.5	3.5	5.0
	% within Health professionals	20%	80%	100%
	% within Hypnosis treatment	5%	8.9%	7.7%
	% of Total	1.5%	6.2%	7.7%
Others	Count	12	11	23
	Expected Count	7.1	15.9	23.0
	% within Health professionals	52.2%	47.8%	100.0%
	% within Hypnosis treatment	60%	24.4%	35.4%
	% of Total	18.5%	16.9%	35.4%
Total	Count	20	45	65
	Expected Count	20	45	65
	% within Health professionals	30.8%	69.2%	100%
	% within Hypnosis treatment	100%	100%	100%
	% of Total	30.8%	69.2%	100%

Fisher's Exact value = 9.084; p-value = 0.021 < 0.05.

Follow-up Chi Square tests were conducted with each pair of health professional groups to examine whether they had significantly different perspectives on hypnosis as a treatment for nail biting. The analysis result indicated that hypnosis was significantly disfavoured as a nail biting treatment by pharmacists compared to

other health professional groups (Fisher's Exact test = 8.665; p-value = 0.004 < 0.05).

4.7.1.3 Psychotherapy

In Table 4-17, in total, 41 health professionals (63.1% of the total) did not support using psychotherapy as a nail biting treatment; and of these, five were medical doctors (12.2%), 17 pharmacists (41.5%), four naturopaths (9.8%), and 15 other health professionals (36.6%). The data analysis showed that there was a significant association between health professions and views about whether or not psychotherapy would be used for nail biting treatment (Fisher's Exact Test = 12.543; p-value = 0.004 < 0.05).

Table 4-17: ***Different professional views on using psychotherapy for nail biting treatment (N=65)***

	Health professions	Yes	No	Total
Medical Doctor	Count	12	5	17
	Expected Count	6.3	10.7	17.0
	% within Health professionals	70.6%	29.4%	100.0 %
	% within Psychotherapy treatment	50.0%	12.2%	26.2%
	% of Total	18.5%	7.7%	26.2%
Pharmacist	Count	3	17	20
	Expected Count	7.4	12.6	20.0
	% within Health professionals	15.0%	85.0%	100.0 %
	% within Psychotherapy treatment	12.5%	41.5%	30.8%
	% of Total	4.6%	26.2%	30.8%
Naturopath	Count	1	4	5
	Expected Count	1.8	3.2	5.0
	% within Health professionals	20.0%	80.0%	100.0 %
	% within Psychotherapy treatment	4.2%	9.8%	7.7%
	% of Total	1.5%	6.2%	7.7%
Others	Count	8	15	23
	Expected Count	8.5	14.5	23.0
	% within Health professionals	34.8%	65.2%	100.0 %
	% within Psychotherapy treatment	33.3%	36.6%	35.4%
	% of Total	12.3%	23.1%	35.4%
Total	Count	24	41	65
	Expected Count	24.0	41.0	65.0
	% within Health professionals	36.9%	63.1%	100.0 %
	% within Psychotherapy treatment	100.0 %	100.0 %	100.0 %
	% of Total	36.9%	63.1%	100.0 %

Fisher's Exact value = 12.543; df =3; p-value = 0.004 < 0.05.

Follow-up Chi Square tests were conducted to each pair of health professional groups to examine whether hypnosis was a favourable treatment for nail biting from health professional perspective. The analysis result indicated that psychotherapy was a significantly favourable treatment for nail biting among medical doctors compared to pharmacists (χ^2= 11.78; df = 1; p-value = 0.001 < 0.05).

4.7.2 Nail biting frequency and other variables

Similarly, Chi-square (χ2) tests were performed to discover possible correlations between nail biting frequency and various self-reported health issues reported by the participating nail biters.

4.7.2.1 Poor diet

As presented in Table 4-18, in total, 20 nail biters (25.3% of the total) reported to have a poor diet; and of these, two nail biters sometimes bit their nails (10%), and 18 nail biters did so over 3 times a day (90%). The data analysis showed that there was a significant association between frequencies of nail biting and poor diet (Fisher's Exact Test = 10.365, p-value=0.024 <= 0.05).

Table 4-18: ***Frequency of nail biting and poor diet (N=79)***

		Yes	No	Don't know	Total
Sometimes	Count	2	3	1	6
	Expected Count	1.5	4.4	0.1	6
	% within Frequency of nail biting	33.3%	50%	16.7%	100%
	% within Poor diet	10%	5.2%	100%	7.6%
	% of Total	2.5%	3.8%	1.3%	7.6%
1 to 3 times a day	Count	0	9	0	9
	Expected Count	2.3	6.6	0.1	9
	% within Frequency of nail biting	0%	100%	0%	100%
	% within Poor diet	0%	15.5%	0%	11.4%
	% of Total	0.0%	11.4%	0.0%	11.4%
Over 3 times a day	Count	18	46	0	64
	Expected Count	16.2	47	0.8	64
	% within Frequency of nail biting	28.1%	71.9%	0%	100%
	% within Poor diet	90%	79.3%	0%	81%
	% of Total	22.8%	58.2%	0%	81%
Total	Count	20	58	1	79
	Expected Count	20	58	1	79
	% within Frequency of nail biting	25.3%	73.4%	1.3%	100%
	% within Poor diet	100%	100%	100%	100%
	% of Total	25.3%	73.4%	1.30%	100%

Fisher's Exact Test = 10.365, p-value=0.024 <= 0.05.

Follow-up Chi Square tests were conducted to each pair of frequency groups to locate statistically significant pairs. The analysis result indicated that poor diet was significantly more prevalent among nail biters who reported 3 times per day than those who reported to bite their nails sometimes (Fisher's Exact Test = 4.958; p-value = 0.044 < 0.05).

4.7.2.2 Parasites or worms

As indicated in Table 4-19, in total, 22 nail biters (27.5% of the total) reported to have parasites or worms; and all of them bit their nails over 3 times a day (100%). The data analysis showed that there was a significant association between

frequency of nail biting and incidence of parasites or worms (Fisher's Exact Test = 10.1, p-value=0.02 <= 0.05).

Table 4-19: ***Frequency of nail biting and parasites/worms (N=80)***

		Yes	No	Don't know	Total
Sometimes	Count	0	4	2	6
	Expected Count	1.7	3.5	0.8	6
	% within Frequency of nail biting	0%	66.7%	33.3%	100%
	% within Parasite/worms	0%	8.5%	18.2%	7.5%
	% of Total	0%	5%	2.5%	7.5%
1 to 3 times a day	Count	0	9	0	9
	Expected Count	2.5	5.3	1.2	9
	% within Frequency of nail biting	0%	100%	0%	100%
	% within Parasite/worms	0%	19.1%	0%	11.3%
	% of Total	0%	11.3%	0%	11.3%
Over 3 times a day	Count	22	34	9	65
	Expected Count	17.9	38.2	8.9	65
	% within Frequency of nail biting	33.8%	52.3%	13.8%	100%
	% within Parasite/worms	100%	72.3%	81.8%	81.3%
	% of Total	27.5%	42.5%	11.3%	81.3%
Total	Count	22	47	11	80
	Expected Count	22	47	11	80
	% within Frequency of nail biting	27.5%	58.8%	13.8%	100%
	% within Parasite/worms	100%	100%	100%	100%
	% of Total	27.5%	58.8%	13.8%	100%

Fisher's Exact Test = 10.1, p-value=0.02 <= 0.05.

Follow-up Chi Square tests were conducted to identify which pairs of frequency groups differed significantly. The analysis result indicated that parasites or worms were significantly more prevalent among nail biters who reported biting their nails over 3 times per day than those who reported to bite their nails 1 to 3 times a day (Fisher's Exact Test = 6.608; p-value = 0.05 <= 0.029).

4.7.2.3 Infections

As shown in Table 4-20, in total, 41 nail biters (51.2% of the total) reported to have infections of different types; among these, 4 nail biters reported to bite their nails sometimes (9.8%), one nail biter reported 1 to 3 times per day (2.4%), and 36 nail biters did so over 3 times per day (87.8%). The data analysis showed that there was a significant association between frequency of nail biting and incidence of infections (Fisher's Exact Test = 10.381, p-value=0.021 <= 0.05).

Table 4-20: ***Frequency of nail biting and infections (N=80)***

		Yes	No	Don't know	Total
Sometimes	Count	4	1	1	6
	Expected Count	3.1	2.6	0.3	6
	% within Frequency of nail biting	66.7%	16.7%	16.7%	100%
	% within Infections	9.8%	2.9%	25%	7.5%
	% of Total	5%	1.3%	1.3%	7.5%
1 to 3 times a day	Count	1	8	0	9
	Expected Count	4.6	3.9	0.5	9
	% within Frequency of nail biting	11.1%	88.9%	0%	100%
	% within Infections	2.4%	22.9%	0%	11.3%
	% of Total	1.3%	10%	0%	11.3%
Over 3 times a day	Count	36	26	3	65
	Expected Count	33.3	28.4	3.3	65
	% within Frequency of nail biting	55.4%	40%	4.6%	100%
	% within Infections	87.8%	74.3%	75%	81.3%
	% of Total	45%	32.5%	3.8%	81.3%
Total	Count	41	35	4	80
	Expected Count	41	35	4	80
	% within Frequency of nail biting	51.2%	43.8%	5%	100%
	% within Infections	100%	100%	100%	100%
	% of Total	51.2%	43.8%	5%	100%

Fisher's Exact Test = 10.381, p-value=0.021 <= 0.05.

Follow-up Chi Square tests were conducted to determine statistical differences among pairs of frequency groups. The analysis result indicated that infections were significantly more prevalent among nail biters who reported biting their nails sometimes than those who reported to bite their nails 1 to 3 times per day (Fisher's Exact Test = 7.503; p-value = 0.011 < 0.05). In addition, infections were significantly more prevalent among nail biters who reported biting their nails over 3 times per day than those who reported to bite their nails 1 to 3 times per day (Fisher's Exact Test = 7.072; p-value = 0.025 < 0.029).

4.7.2.4 Cold sores

As shown in Table 4-21, in total, 41 nail biters (51.2% of the total) reported to have cold sores; among these, two nail biters reported to bite their nails sometimes (20%), two nail biter reported 1 to 3 times per day (20%), and 6 nail biters did so over 3 times per day (60%). The data analysis showed that there was a significant association between frequency of nail biting and incidence of cold sores (Fisher's Exact Test = 8.816, p-value=0.047 <= 0.05).

Table 4-21: ***Frequency of nail biting and cold sores (N=80)***

		Yes	No	Don't know	Total
Sometimes	Count	2	3	1	6
	Expected Count	0.8	5.1	0.2	6
	% within Frequency of nail biting	33.3%	50.00%	16.7%	100%
	% within Cold sores	20%	4.4%	50%	7.5%
	% of Total	2.5%	3.8%	1.3%	7.5%
1 to 3 times a day	Count	2	7	0	9
	Expected Count	1.1	7.7	0.2	9
	% within Frequency of nail biting	22.2%	77.8%	0%	100%
	% within Cold sores	20%	10.3%	0%	11.3%
	% of Total	2.5%	8.8%	0%	11.3%
Over 3 times a day	Count	6	58	1	65
	Expected Count	8.1	55.3	1.6	65
	% within Frequency of nail biting	9.2%	89.2%	1.5%	100%
	% within Cold sores	60%	85.3%	50%	81.3%
	% of Total	7.5%	72.5%	1.3%	81.3%
Total	Count	10	68	2	80
	Expected Count	10	68	2	80
	% within Frequency of nail biting	12.5%	85%	2.5%	100%
	% within Cold sores	100%	100%	100%	100%
	% of Total	12.5%	85%	2.5%	100%

Fisher's Exact Test = 8.816, p-value=0.047 <= 0.05.

Follow-up Chi Square tests were conducted to each pair of frequency groups to examine whether the existence of cold sores was significantly associated with particular nail biting frequencies. The analysis result indicated cold sores were significantly more prevalent among nail biters who reported biting their nails over 3 times per day than those who reported to bite their nails sometimes (Fisher's Exact Test = 7.349; p-value = 0.037 < 0.05).

Chi-square ($\chi 2$) tests were also performed to discover possible correlations between nail biting frequency and health issues diagnosed by doctors. The tests with significant results are presented below.

4.7.2.5 Joint pain

As indicated in Table 4-22, in total, 16 nail biters (20% of the total) reported to have joint pain diagnosed by the doctor; among these, one nail biter reported to bite their nails sometimes (6.3%), and 15 nail biters did so over 3 times per day (93.8%). The data analysis showed that there was a significant association between frequency of nail biting and diagnosed joint pain (Fisher's Exact Test = 13.84, p-value=0.004 <= 0.05).

Table 4-22: ***Frequency of nail biting and joint pain (N=80)***

		Yes	No	Don't know	Total
Sometimes	Count	1	3	2	6
	Expected Count	1.2	4.6	0.2	6
	% within Frequency of nail biting	16.7%	50%	33.3%	100%
	% within Joint pain	6.3%	4.9%	66.7%	7.5%
	% of Total	1.3%	3.8%	2.5%	7.5%
1 to 3 times a day	Count	0	8	1	9
	Expected Count	1.8	6.9	0.3	9
	% within Frequency of nail biting	0%	88.9%	11.1%	100%
	% within Joint pain	0%	13.1%	33.3%	11.3%
	% of Total	0%	10%	1.3%	11.3%
Over 3 times a day	Count	15	50	0	65
	Expected Count	13	49.6	2.4	65
	% within Frequency of nail biting	23.1%	76.9%	0%	100%
	% within Joint pain	93.8%	82%	0%	81.3%
	% of Total	18.8%	62.5%	0%	81.3%
Total	Count	16	61	3	80
	Expected Count	16	61	3	80
	% within Frequency of nail biting	20%	76.3%	3.8%	100%
	% within Joint pain	100%	100%	100%	100%
	% of Total	20%	76.3%	3.8%	100%

Fisher's Exact Test = 13.84, p-value=0.004 <= 0.05.

Follow-up Chi Square tests were conducted to each pair of frequency groups to identify which nail biting frequencies were responsible for the significant findings.

The analysis result indicated that join pain was significantly more prevalent among nail biters who reported biting their nails over 3 times per day, compared to those who reported to bite their nails sometimes (Fisher's Exact Test = 10.161; p-value = 0.009 < 0.05) and 1 to 3 times per week (Fisher's Exact Test = 6.442; p-value = 0.037 < 0.05).

4.7.2.6 Other health issues

As can be seen Table 4-23, in total, 37 nail biters (46.3% of the total) reported to have other health issues diagnosed by the doctor; among these, four nail biters reported to bite their nails sometimes (10.8%), and one nail biter reported 1 to 3 times per week (2.7%), and 32 did so over 3 times per day (86.5%). The data analysis showed that there was a significant association between frequency of nail biting and other health issues (Fisher's Exact Test = 13.165, p-value=0.006 <= 0.05).

Table 4-23: ***Frequency of nail biting and other health issues (N=-80)***

		Yes	No	Don't know	Total
Sometimes	Count	4	1	1	6
	Expected Count	2.8	3.2	0.1	6
	% within Frequency of nail biting	66.7%	16.7%	16.7%	100%
	% within Other	10.8%	2.4%	100%	7.5%
	% of Total	5%	1.3%	1.3%	7.5%
1 to 3 times a day	Count	1	8	0	9
	Expected Count	4.2	4.7	0.1	9
	% within Frequency of nail biting	11.10%	88.90%	0%	100%
	% within Other	2.7%	19%	0%	11.3%
	% of Total	1.3%	10%	0%	11.3%
Over 3 times a day	Count	32	33	0	65
	Expected Count	30.1	34.1	0.8	65
	% within Frequency of nail biting	49.2%	50.8%	0%	100%
	% within Other	86.5%	78.6%	0%	81.3%
	% of Total	40%	41.3%	0%	81.3%
Total	Count	37	42	1	80
	Expected Count	37	42	1	80
	% within Frequency of nail biting	46.3%	52.5%	1.3%	100%
	% within Other	100%	100%	100%	100%
	% of Total	46.3%	52.5%	1.3%	100%

Fisher's Exact Test = 13.165, p-value=0.006 <= 0.05

Follow-up Chi Square tests were conducted to determine which pairs of frequency groups differed significantly. The analysis result indicated other health issues were significantly more prevalent among nail biters who reported biting their nails sometimes compared to those who reported to bite their nails 1 to 3 times per day (Fisher's Exact Test = 7.053; p-value = 0.011 < 0.05).

4.7.2.7 Mental health issues

As can be seen Table 4-24, in total, 23 nail biters (28.7% of the total) reported to have mental health issues, including depression, Tourette syndrome, anxiety, psychological disorder, etc.; all of these nail biters reported to bite their nails over 3 times per day (100%). The data analysis showed that there was a significant association between frequency of nail biting and mental health issues (Fisher's Exact Test = 7.127, p-value=0.02 <= 0.05).

Table 4-24: ***Frequency of nail biting and mental health issues (N=80)***

		Yes	No	Total
Sometimes	Count	0	6	6
	Expected Count	1.7	4.3	6
	% within Frequency of nail biting	0%	100%	100%
	% within Mental health issues	0%	10.5%	7.5%
	% of Total	0%	7.5%	7.5%
1 to 3 times a day	Count	0	9	9
	Expected Count	2.6	6.4	9
	% within Frequency of nail biting	0%	100%	100%
	% within Mental health issues	0%	15.8%	11.3%
	% of Total	0%	11.3%	11.3%
Over 3 times a day	Count	23	42	65
	Expected Count	18.7	46.3	65
	% within Frequency of nail biting	35.4%	64.6%	100%
	% within Mental health issues	100%	73.7%	81.3%
	% of Total	28.7%	52.5%	81.3%
Total	Count	23	57	80
	Expected Count	23	57	80
	% within Frequency of nail biting	28.7%	71.3%	100%
	% within Mental health issues	100%	100%	100%
	% of Total	28.7%	71.3%	100%

Fisher's Exact Test = 7.127, p-value=0.02 <= 0.05.

Follow-up Chi Square tests were conducted to identify which pairs of frequency groups differed significantly in terms of mental health. The analysis result indicated that mental health issues were significantly more prevalent among nail biters who reported biting their nails over 3 times per day than those who reported to bite their nails 1 to 3 times per day (Fisher's Exact Test = 4.621; p-value = 0.05 <= 0.05).

4.7.2.8 Lack of fruit and vegetable consumption

As presented in Table 4-25, in total, 15 nail biters (18.8% of the total) reported a lack of fruit and vegetable consumption; among them, two nail biters reported to bite their nails sometimes (13.3%), four nail biters reported a frequency of 1 to 3 times per day (26.7%), and nine nail biters dis so over 3 times per day (60%). The data analysis showed that there was a significant association between frequency of nail biting and the lack of fruit and vegetable consumption (Fisher's Exact Test = 5.704, p-value=0.039 <= 0.05).

Table 4-25: ***Frequency of nail biting and dislike fruits and vegies (N=80)***

		Yes	No	Total
Sometimes	Count	2	4	6
	Expected Count	1.1	4.9	6
	% within Frequency of nail biting	33.3%	66.7%	100%
	% within Dislike fruits and vegies	13.3%	6.2%	7.5%
	% of Total	2.5%	5%	7.5%
1 to 3 times a day	Count	4	5	9
	Expected Count	1.7	7.3	9
	% within Frequency of nail biting	44.4%	55.6%	100%
	% within Dislike fruits and vegies	26.7%	7.7%	11.3%
	% of Total	5%	6.3%	11.3%
Over 3 times a day	Count	9	56	65
	Expected Count	12.2	52.8	65
	% within Frequency of nail biting	13.8%	86.2%	100%
	% within Dislike fruits and vegies	60%	86.2%	81.3%
	% of Total	11.3%	70%	81.3%
Total	Count	15	65	80
	Expected Count	15	65	80
	% within Frequency of nail biting	18.8%	81.3%	100%
	% within Dislike fruits and vegies	100%	100%	100%
	% of Total	18.8%	81.3%	100%

Fisher's Exact Test = 5.704, p-value=0.039 <= 0.05.

Follow-up Chi Square tests were conducted to identify which pairs of frequency groups differed significantly in relation to the lack of fruit and vegetable consumption. The analysis result indicated that a lack of fruit and vegetable consumption was significantly more prevalent among nail biters who reported biting their nails 1 to 3 times per day than those who reported to bite their nails over 3 times per day (Fisher's Exact Test = 5.111; p-value = 0.037 < 0.045).

4.8 Summary of quantitative findings

The quantitative data were statistically analysed and the findings were presented thematically. As indicated in the chapter, the data collected from the survey provided a general understanding about the nail biters and parents of nail biting children regarding their perceived causes of nail biting, associated health issues, and possible treatments of nail biting.

From the perspective of the participating nail biters and parents of nail biting children on the common causes of nail biting, the results showed that psychological imbalances, such as anxiety, nervousness, or stress, were believed by the largest proportion of the respondents to mainly lead to the development of nail biting habit. For them, other factors include mineral deficiency, poor diet, and psychological disorders. Further statistical details pertaining to their perceived causes of nail biting are as follows. The third primary issue of interest in the survey was related to the treatment of nail biting from the experiences of the surveyed nail biters. The results showed that the most widely used treatment for nail biting was the use of bitter nail polish, followed by mineral supplements and punishment. Medication and other psychotherapies were also used. The respondents also mentioned other treatments used only occasionally, which included the use of fake nails, Oroxine, Pedisure formula, ceasing drinking coffee, will power, and gluten free diet.

From the perspective of health professionals regarding the perceived causes of nail biting, associated health issues, and possible treatment of nail biting. The results showed that they strongly believed the main possible cause of nail biting was psychological imbalances, such as anxiety, nervousness and stress. Interestingly, a high proportion of the respondents attributed nail biting to psychological imbalances. Psychological disorder and poor diet were also seen as the causes of nail biting. However, a low number of participants were not so sure about this relationship. Mineral deficiency came fourth in the list of perceived causes of nail biting. Genetic disorder was cited by 32% of the health professionals to be the main cause of nail biting. While 28% did not reject the link between genetic disorders with nail biting, 40% were not sure about the association between them.

In relation to the associated health issues that were experienced by their nail-biting patients in the past five years, according to the health professionals, the most prevalent health issue among nail biters was the existence of parasites/worms. Bacterial/viral infections were also very popular. Other health problems were gingivitis, fungal infections, and diarrhoea.

In relation to their recommended treatment methods for nail biting, the results indicated that a very large proportion of the health professionals recommend the use of bitter nail polish as a treatment method for nail biting. Nearly half of health professionals suggested the use of mineral supplements and a smaller proportion were in favour of psychotherapy and hypnosis. Medication and punishment were found to be unpopular treatment methods. Regarding the recommended mineral supplements, the health professionals highly recommended Calcium. Other frequently recommended minerals were Magnesium, Silica, Iron, Schuessler Potassium Phosphate in the form of Tissue Salts or Celloid, and Zinc.

4.9 Conclusion

This chapter has reported the findings of the questionnaire data from health professionals, nail biters and parents of nail biting children, including participants' demographics. As the focus of the discussion presented in this chapter is on quantitative data analysis, the research tools used in the data collection were revisited and the findings were described and explained in terms of descriptive and inferential statistics, particularly in relation to the possible links between a number of quantitative variables. Though the insights gained from the statistical revelations are interesting and valuable, they are only one part of the research endeavour. The next chapter will be complementary as its focus is on the qualitative side of the coin where participants' perception, experience, and attitudes towards nail biting are examined in terms of meaning instead of numbers.

5 Qualitative Data Analysis

5.1 Introduction

As indicated in the methodology chapter, this study used the mixed methods approach to deal with the complex issue of nail biting. The key rational is that such a combined methods approach can enrich the findings and interpretation. Both quantitative and qualitative methods are powerful in its own way as each provides a specific aspect of the research problem, whereas a combination of both methods provides further insights into the complexity of the research issue. They are mutually complementary in research exploration. Chapter 4 has outlined and highlighted the analysis results of the survey questionnaires for health professionals, nail biters and parents of nail biters. This chapter provides a different side of the research issues in which personal expressions, ideas, attitudes, feelings and thoughts reflect the inner world of the participants that statistics could not adequately present.

5.2 Data analysis

This chapter reports the analysis of the qualitative data collected from the interviews conducted with 23 past/current nail biters or parents of nail biters, 14 health professionals, and 15 written comments from the questionnaires.

The interviews and written comments were used to provide further insights to RQ1 and RQ2 of the study.

> RQ1. What are the views of nail biters and parents of nail biting children in Tasmania, Australia on the possible causes, associated health issues, and treatment of nail biting?
>
> RQ2. What are the views of Australian health professionals on the possible causes, associated health issues, and treatment of nail biting?

The data from the interviews, particularly with the parents of nail biters, nail biters and health professionals, shed interesting lights on the researched issue with their first hand experiences from the perspectives of both patients and health experts. The data were analysed and presented in terms of the pre-defined themes/subthemes related to the RQs as well as those emerging from the extensive conversations. The themes that emerged from the nail biters or parents of nail biters and health professionals were reported in separate sections, and will be discussed in reference to each other in the next Discussion chapter to highlight and reinforce identified themes.

Initially, the characteristics of the participants are presented, which are followed by the presentation of themes from the data analysis. In addition to each major theme, additional sub-themes and sub-sub themes were developed and are presented in this chapter.

The qualitative data collected from the interviews and comments from the open question of the questionnaires were organised and analysed using NVivo v10.0, a software package for qualitative research (QRS International, 2012). As part of the analysis, the data were coded and organised by being placed into 'nodes.' The nodes at the beginning stage provided some indication about key semantic features which had the potential connections among the nodes. In this way, conducting a research involves meaning making in the data analysis as it attempts to create nodes from a wealth of qualitative data and arrange them in a thematic structure. Meaning making also designates the way in which participants express their own thoughts and feelings about a social issue in context. They were also the base on which themes and subthemes emerged and were identified. In a sense, it was the meaning making process in qualitative research. Initially the researcher needed to sketch out a framework of themes and subthemes and finally examined the nature of the relations between nodes and themes. This thematic process involved sorting, rearrangement, identification, classification and final thematic construction.

Within thematic analysis, the results were presented in terms of themes, including positive and negative attitudes and views of the interviewees as outlined in Table 5.1 and Table 5.2.

Table 5-1: ***Coding used within thematic analysis of health professionals***

Themes	Sub-themes
Nail biting behaviour	
Causes of nail biting	– Mental health illness
	– Mineral and vitamins deficiency
	– Family welfare or domestic issues
	– Parasites
Methods used to diagnose nail biting	– Diagnostic approach
	– Diagnostic tests used
	– Mental health and other methods
Recommended treatments	– Psychological treatment
	– Iron deficiency and thyroid disorders
	– Bitter nail polish
	– Mineral and vitamin supplements
	– Worm treatment
	– Specialist referrals
Advice on treatment and prevention of nail biting	– Awareness of infections and other confounding symptoms
	– Screening for other/confounding health issues
	– Healthy diet
	– Early intervention for better health outcomes
	– Other advices

Table 5-2: ***Coding used within thematic analysis of nail biters***

Themes	Sub-themes
Reasons of nail biting	– Emotion
	– Dietary
	– Lifestyles
Nail biting and associated health issues	– Psychological disorders
	– Frequent eye twitching
	– Muscle cramp and joint pain
	– Vitamin and mineral deficiency
	– Constipation and gastric disorders
	– Other associated health issues
Commencement of nail biting habit	
Persistence to stop nail biting	
Parental influence	
Types of treatment received	– Bitter nail polished
	– Psychotherapy
	– Vitamin and mineral supplements
	– Cessation of caffeine consumption
	– Parasite detox
	– Other types of treatment
Health professional's assistance	

5.3 Profile of participants

5.3.1 Characteristics of health professionals

As indicated in Table 5-3, the majority of the respondents were general practitioners (43%), followed by pharmacists (21%) and naturopaths (21%). Fourteen per cent of other professions included in the interview were psychologist, and nutritionist.

Table 5-3: Characteristics of health professionals (N=14)

Health Professionals	n (%)
General practitioners	6 (43)
Naturopath	3 (21)
Nutritionist	1 (7)
Pharmacist	3 (21)
Psychologist	1 (7)
Grand Total	**14**

5.3.2 Characteristics of nail biters

According to the information provided by the interviewed nail biters and parents of nail biters, 67.2% of the studied nail biters were 18 years of age, 22.8% of them were less than 18 years of age. The majority of the sampled nail biters were current nail biters (82.6%) and they started nail biting habit in their childhood (82.6%).

Table 5-4: Characteristics of nail biters (N=23)

Characteristics	n (%)
Age groups	
- **Less than 18 yrs**	8 (22.8)
- **18yrs and over**	15 (67.2)
Nail biting status	
- **Past**	4 (17.4)
- **Current**	19 (82.6)
Commencement of nail biting	
- **Childhood**	19 (82.6)
- **Teenage hood**	4 (17.4)
Nail biter groups	
- **Parents of nail biters**	8 (22.8)
- **Nail biters**	15 (67.2)

5.4 Health professionals' perspective

The interviewed health professionals were keen to shed light on the researched issue of nail biting with clearly articulated views on the possible causes, and method of diagnosis and treatments for nail biting. On the basis of their professional experience and observations, the interviewed participants suggested a range of different causes and treatments, painting a relatively comprehensive picture of this

complex issue of nail biting. Note-worthily, each of the participants did not exclusively attribute any single cause to nail biting, but tended to link nail biting to a variety of contributing factors.

5.4.1 Cause of nail biting: The health professionals' perspective

The data analysis indicated that the professional health workers held different views on the possible causes of nail biting, probably because of their diverse professional backgrounds and approaches. These identified causes fell two main sub-themes: psychological and nutritional or physiological factors. The former involves anxiety and stress while the latter covers mineral or vitamin deficiency, diet/malnutrition, thyroid disorders, and parasites.

5.4.1.1 Psychological factors

There was a strong indication from the comments of the health professionals that nail biting is generally caused by psychological factors such as anxiety, stress, and nervousness.

Firstly, many health professionals identified anxiety as an important contributing factor to the development of nail biting habit. Accordingly, nail biting was explained as a "nervous habit related to an unhealthy way to reduce or regulate anxiety" (HP-4). It is important to note that these health professional tended to speak with absolute certainty regarding this causal link between anxiety and nail biting. The following remark clearly illustrates this point.

> *Generally, nail biting is caused by anxiety. (HP-11)*

> *Anxiety tends to associate with nail biting. (HP-10)*

A few health professional participants also discussed anxiety as an underlying cause of nail biting among adults, referring specifically to the issue of obsessive-compulsive disorder (OCD). For example, HP-1 noted, "In adult, the underlying causes of nail biting are usually obsessive compulsive disorder (OCD) or thyroid problems." OCD is basically an anxiety disorder among people who tend to perform

repetitive excessive actions in dealing with persistent unwanted obsessions. It is interesting to note the widely held perception that there seems to be an association between nail biting and anxiety or psychological or emotional conditions in general.

As another psychological factor, stress was also described as a possible cause of nail biting by the participating health professionals. For many of them, stress felt by the nail biting patients could be built up from various reasons. These reasons were in turn associated with other psychological and socioeconomic factors, including anxiety, familial issues, or major changes to one's personal life. A participant indicates:

> *Nail biting could be caused by other health issues, anxiety, any stress, and family problems such as parents recently divorce or changing school. (HP-2)*

The third psychological factor noted by the health professional participants was related to nervousness. Nervous system was believed to be triggered by different agents. Interestingly, intestinal parasites were hypothetically linked to nervousness, which then led to nail biting as a self-calming mechanism.

> *Nail biting could be commonly caused by intestinal parasites. Intestinal parasite maybe the cause of nervousness in children hence nail biting maybe a symptoms of nervousness. (HP-7)*

Generally, a recurring theme highlighted by the health professionals was that a disturbance to or instability in emotional and psychological state could result in nail biting habit in the patient as an attempt to cope and regain balance.

5.4.1.2 Nutritional deficiency / Physiological factors

Apart from the psychological factors, the participating doctors also believed that nail biting could be caused by other nutritional/physiological elements. Particularly, mineral deficiency was stressed by most participants as an important contributing factor to nail biting. The shortage of many minerals was specifically mentioned to be at play, including calcium, silica, magnesium, potassium, and zinc. It is worth noting that this factor of mineral deficiency was widely expressed in a number of

statements, reflecting a high confidence level among the health professionals. Some of the comments are presented below.

> *Mineral deficiency is probably the initial cause of nail biting in children. It could be any minerals but the common deficient mineral that I found is Calcium and Silica. (HP-3)*
>
> *Mineral deficiency, commonly calcium, magnesium, potassium, silica and zinc. (HP-5)*
>
> *Intestinal parasites can also reduce the amount of nutrients that are being absorbed by the body so it could cause a decrease in the amount of essential minerals (such as calcium, magnesium, zinc, silica and iron) being absorbed from food. (HP-7)*
>
> *Calcium deficiency tend to be the common causative trigger of nail biting in children. (HP-8)*
>
> *Mineral deficiency, particularly Calcium or Magnesium or Silica or iron. (HP-9)*
>
> *I find people biting nails for many reasons but mineral deficiency is the most common initial cause of nail biting in children. (HP-10)*

While discussing mineral deficiency in relation to nail biting, some health professional even attempted to provide possible explanations, such as mal-absorption disorder (HP-9) or poor diet (HP-10).

Apart from mineral deficiency, other types of nutritional deficiencies and disorders were noted by the health professionals as an underlying cause of nail biting. The frequently mentioned issues included iron deficiency, and mineral deficiency or thyroid disorders. One of thyroid's main functions is to maintain body's metabolism, and thus thyroid disorder could detrimentally affect the production of energy from food or nutritional sources.

However, nail biting could be caused by other underlying causes such as iron deficiency or thyroid disorders, especially hypothyroidism or hyperthyroidism. (HP-1)

Nail biting in children is commonly caused by iron deficiency or just a growing up habit. (HP-14)

Recent test for Vitamin D level. (HP-2)

As a whole, there was a general agreement among the participating health professionals that nail biting was associated with a wide range of psychological and physiological/nutritional causes. It was felt that no single factor could be used to fully explain the development of nail biting habit.

5.4.2 Diagnosis methods for nail biting

As indicated in the data analysis about the perceived causes of nail biting, different causes were seen as the contributing factors. This was consistently reflected in the data analysis about the diverse methods used to diagnose nail biting.

5.4.2.1 Diagnostic approaches

The interview data revealed that the very first step to take for health professionals upon consulting a nail biting patient was to carefully examine the condition of the nails and the surrounding areas. This preliminary check was meant to give them a rough idea of the seriousness of the nail biting habit, which might partly inform them of the possible causes and appropriate treatment. The following comments clearly illustrate this practice.

Examine the fingernails for shortness, injuries, dermatitis, and infections. (HP-7)

Examine the nails for shortness, infections and injuries. (HP-10)

Due to the inconclusive views about the primary cause of nail biting, the participating health professionals reported a wide range of different diagnostic

approaches that were consistent with their perceived main causes. The diagnostic approaches include, for example, “checking for mineral deficiency, infections, injuries, symptoms of thyroid disorder, anxiety, depression, difficulty of losing weight or gain weight, and heat or cold sensitivity” (HP-1).

It is important to note that the health professionals had a tendency to utilise a combination of diagnostic approaches, rather than relying on one single approach. Many of them spoke about the use of survey questionnaire that examined various related clinical and nutritional issues. This practice was manifested in the following comments.

> *Check their nails, questionnaires regarding their diet, milk intake, taking any medications or supplement, other health symptoms and frequency of nail biting. (HP-5)*

> *Use questionnaire with focus on diet, milk intake, frequency, severity, parasites, family history, fussy eating, other symptoms and medical problems. (HP-13)*

Those who associated nail biting with psychological factors would primarily elicit information related to symptoms of stress, or anxiety. As noted by a health professional, he would

> *Ask about their emotions, any stress (such as parents divorced, changing schools) (HP-3)*

> *An anxiety test such as DASS combined with frequency diary to look for Level of anxiety and high frequency of nail biting. (HP-4)*

On the other hand, the health professionals who attributed nail biting mainly to physiological factors would look for traces of nutritional deficiency. Below are a number of typical responses on the diagnostic approaches of this type.

> *I will check for any infection, shortness of the nails, signs of mineral deficiency appear on the nails such as ridges, white spots etc. (HP-2)*

I generally look at the nails, the eyes and tongue for signs of nutritional deficiency. Sometimes I may ask the patients to go back to GP and ask for Red blood cells mineral analysis. I find the general blood test (the serum) is not the good indicator of the body mineral. (HP-2)

I generally look at the nail, iris and tongue for mineral analysis … signs of parasites, their diet, milk intake, other health issues, food allergies and eating problems. (HP-3)

5.4.2.2 Diagnostic tests used

Apart from the general examination of nail biting patients as mentioned above, it was stated that diagnostic tests were also conducted for evidence of issues that were not readily observable. Particularly, tests for iron and mineral deficiency were indicated to be frequently used. A health professional, for example, reported the use of "Iron blood test and thyroid function test" (HP-1) to confirm if there were any "Iron deficiency, and also the TSH, T3 and T4 levels." (HP-1). The following cited statements give some details on the diagnostic tests taken by doctors in dealing with nail biting.

I may order blood test occasionally in some patients to look for Vitamin D and iron levels. (HP-7)

Sometimes I may order Hair Tissue Analysis but it is expensive and often the patients are reluctant with the test. (HP-3)

Red blood cell elemental mineral analysis and nail diagnosis to look for mineral deficiency and toxicity. (HP-5)

I use nail, tongue, facial, and iris analysis as a general diagnostic test. Sometimes I recommend hair tissue mineral analysis to look for signs of particular mineral deficiency such as white spots on nails, horizontal ridges, clubbing, longitudinal ridges and brittle nails. (HP-9)

For adult I will do RBC elemental analysis, nail, face and tongue analysis. For children, it's very difficult to take blood test from them hence I usually do Hair tissue mineral analysis, nail, face, tongue analysis to identify particular mineral deficiency or imbalance. Blood tests are also ordered in some children. (HP-10)

Depending on the severity of nail biting and other co-occurring symptoms or health issues. I may do nail diagnosis, blood test, hair tissue mineral analysis, RBC test… to check mineral imbalances and heavy metal toxicity. (HP-11)

5.4.3 Recommended treatments

There was an indication from the interview data with health professionals that treatment of nail biting was difficult as the primary causes for nail biting in children and adults were not fully understood and therefore hard to identify. This is confirmed by the following survey participant.

Very difficult to treat! (HPS-59)

Generally, the recommended treatment methods were consistent with the diagnostic results, whereby the identified causes would be directly dealt with to control their consequent action of nail biting. These methods can be classified into three main categories of cognitive-behavioural therapy, supplement or medication, and educational program. Each of these categories is reported in detail below.

5.4.3.1 Cognitive-behavioural therapy

According to the interview data, the participating health professionals would recommend a range of treatments related to cognitive-behavioural therapy, especially when psychological factors (e.g., anxiety, or stress) were identified as a cause or being closely associated with nail biting. Cognitive-behavioural therapy or psychotherapy targets the thought and the action of nail biting. Importantly, because these patients were more vulnerable to psychological problems, thus "generally sensitive and fragile", it was suggested, "A lot of respect, care and thoughtfulness is required (HP-4). "Be patient" (HP-6) was also highly

recommended in the treatment of nail biting. The variety of recommended cognitive-behavioural treatments included many behaviour modification techniques to decrease nail biting such as hypnotherapy, habit reversal training, and aversion therapy.

Hypnotherapy, a kind of cognitive-behavioural therapy that targets the unconscious element of the habit, was believed by some health professional participants to be an effective treatment approach, especially for adult nail biters.

> *Adult nail biters tend to develop severe compulsive nail biting hence treating adult nail biter requires both nutritional correction as well as treating the compulsive habit. I find hypnosis is quite effective in helping the compulsive behaviours for many patients. (HP-10)*
>
> *Try hypnosis as it has been successfully helping many nail biters to break the stubborn habit. (HP-11)*
>
> *Treatment (kinesiology technique, hypnosis) requires both correcting the initial cause and the removal of habit by using kinesiology technique to identify mineral deficiency, and hypnosis to remove the bad habit. (HPS-65)*

Habit reversal training, another cognitive-behavioural therapy, was also recommended by the participating health professionals. This therapy usually involves assessing issues associated with the occurrence of the nail biting habit, identifying reasonable replacement behaviour, and replacing the habit with an incompatible response. For example, “Emotional Freedom Technique” or the use of health snack and chewing gum were reported to bring about long-term success despite minimal amount of required effort.

> *EFT is “Emotional Freedom Technique” for management of anxiety and help to break the habit of nail biting. I have found good success with minimal effort and lasting results. (HP-11)*
>
> *Redirect nail biting to a chewing gum, healthy snacks. (HP-14)*

Substitute the habit with a healthy snack such as chew on carrot, apple or celery. (HP-10)

Substitute the nail biting habit with a more positive habit. (HP-7)

The use of aversion therapy, which presents an unpleasant experience for nail biters, was perceived as an effective cognitive-behavioural treatment method. Especially for those patients without other clinical issues, bitter nail polish could be used as an appropriate nail biting deterrent. Recommendations for the use of this method were made by quite a few health professionals.

If the patients have just got the nail biting habit alone (such as no problems with iron, thyroid and anxiety) then I would recommend the bitter nail polish as a nail biting deterrent. (HP-1)

If parasites and mineral deficiency are excluded or corrected, a simple bitter nail polish is recommended to stop nail biting. (HP-7)

Use a bitter tasting nail polish applied on the nails. (HP-11)

5.4.3.2 Supplement and medication treatment

As indicated in the presentation about the causes of nail biting, psychological disorders, nutritional deficiency and thyroid problems can be causing factors. Thus treatment of nail biting needs to take those into account with the use of supplements or medication.

Regarding supplement and medication treatment, it was recommended by some health professionals to use anti-anxiety medicine where appropriate. However, it was noted that medication was more suitable for severe cases of nail biting, which reflected symptoms of an obsessive-compulsive disorder or thyroid problems. Some typical recommendations are as follows.

For nail biter with anxiety, anti-anxiety meds are recommended such as Diazepam, SSRI. (HP-1)

For severe adult nail biter, the habit tends to become very stubborn and can become obsessive compulsive disorder- I use SSRI. (HP-7)

If the patient has thyroid problems then thyroid medications are commenced. (HP-1)

For other nutritional deficiency, the use of supplements was highly suggested by the health professionals as an important treatment for nail biting. For example, if the patient suffered from iron deficiency, then the practitioner would recommend Iron supplements such as “Incremens, Floradix, or Ferrogradumet + C” (HP-1). In most cases, a combination of supplements, including calcium, vitamin, magnesium and silica, were referred to as being collectively effective. One health professional elaborated on this therapy in the following remark.

I believe that calcium deficiency is the leading cause of nail biting in children. However, Calcium requires other minerals (such as Magnesium and Silica) and Vitamin D for absorption and metabolism. Therefore I usually recommend a good source of calcium supplement together with Vitamin D, magnesium and Silica. I also add on Schuessler Tissue salts “comb U” or “Kidz strong bone and teeth” to speed up assimilation of the mega dose mineral and to get a quick response. (HP-11)

With the same viewpoint, other participants proposed various types of supplements as a treatment for nail biting.

I find that Blackmores Celloid Calcium Phosphate, Potassium phosphate and Magnesium phosphate are often effective in treating nail biting, especially in children. (HP-2)

Vitamin D is also added to the above treatment regime if they are Vitamin D deficiency. (HP-12)

BM Celloid calcium and Silica and together with Schuessler Tissue salts Kidz Be calm which also contains of Kali phos, mag phos, Ferr phos and silica. (HP-3)

Good diet rich in calcium, magnesium, silica and zinc such as 500ml-1L of milk a day, yogurt, chia seeds, nuts and bananas… Treating nail biting is very successful with mineral supplement together with a good diet. (HP-5)

Vitamin D, Calcium, iron or magnesium. The mineral supplement is varied with patients. (HP-7)

Calcium or magnesium or iron or silica. (HP-9)

I would recommend Seagreens to both children and adults. Seagreens is a great food source of essential minerals, vitamins and amino acids. It's excellence at balancing the body system…I have been successfully treating nail biting children and adults with Seagreens which is concentrated with high quality amount of many vital minerals and nutrition. (HP-10)

It is interesting to note that worm treatment was also recommended as it is related to parasite-based problems mentioned earlier.

I often recommend worm treatment to most nail biting children. Symptoms of intestinal parasites include nausea, weakness, diarrhoea, abdominal pain, constant hunger or loss of appetite, fatigue and weight loss. However, often having intestinal parasites does not cause symptoms. The most obvious signs of worm infestation is the present of worms in a bowel movement (faeces). (HP-7)

5.4.3.3 Health educational programs

Apart from the cognitive-behavioural and medication therapies that seek to make direct adjustments to the behaviours of nail biting, health educational programs also emerged from the interviews as a practical preventative measure to heighten the awareness of children and parents. The following comments provide detailed information on this approach.

Psycho education, insight and behaviour change work. (HP-4)

Learn to aware of the habit and try to avoid it. (HP-10)

Teach patients to aware of worm infestation symptoms and check their faeces. (HP-7)

5.4.4 Advice on treatment and prevention of nail biting

The second part of the qualitative question asked the health professionals for advice they would provide to the nail biters. The given advices are grouped under the following themes: awareness, health screening, healthy diet, and early intervention.

5.4.4.1 Awareness of infections and other confounding symptoms

Awareness is commonly included in any advice to patients with any health problems and so it is with nail biting. As a participant suggested, children and adults alike need to "be more aware of the habit." (HP-7). Thus, it was important to "explain the possible consequences of nail biting" (HP-5) to highlight the fact that it might be a pathologic issue rather than just a harmless habit. The interview data with health professionals also revealed that it was considered important to be fully aware of the symptoms associated with nail biting, for example, anxiety, depression or thyroid disorders. One participant justified the necessity of this awareness in his comment.

Be aware of infections and other accompanying symptoms. Many nail biters are commonly suffering from anxiety and depression. It is often thought that anxiety and depression are the common cause of nail biting. There is an association of anxiety, depression and thyroid disorders. Anxiety and depression are the common symptoms of hyperthyroidism or hypothyroidism. (HP-1)

5.4.4.2 Screening for health issues

From the view of the participating health professionals, screening for related health issues was very important because it helped to identify the underlying cause of nail biting, and thus facilitated the prevention of this habitual disorder. This advice can be seen in the comments below.

Screening for other health conditions is very important to identify the underlying cause of nail biting. (HP-1)

It is important to identify other health symptoms and treat them together with the nail biting condition rather than a condition to be treated in isolation. (HP-3)

Find out the root cause of nail biting and treat it accordingly… (HP-7)

5.4.4.3 Healthy diet

Some participating health professionals gave advice on the adoption of a healthy diet, which is important not only for preventing nail biting, but also for a more generally healthy life. As explained by HP-11, "The body urges the person to bite nails probably to meet the calcium, silica and magnesium requirement." Other health professionals supported this viewpoint, with HP-10 added further, "Nail biting is an indication of nutritional deficiencies hence until you correct the mineral deficiency then no matter what method you use, the child will keep nail biting. The body tries recycling minerals from the nail back to the body."

In fact, the theme of a healthy diet as an effective preventative approach echoed throughout the interviews, indicating a general agreement among the health professionals. In their opinions, a healthy diet would cover a wide range of nutritional food, with the fundamentals being milk, fruits and vegetables. Some typical advices are presented below.

Promote a healthy diet and be aware of the habit. (HP-1)

To substitute the nail biting habit with a healthy snack such as carrots, fruits and vegetables. They are a good source of Vitamins and mineral. (HP-2)

Drink 1 litre of milk a day as children is at growing stage and they require high amount of calcium. Eat plenty and variety of vegetables and fruits especially bananas as bananas are rich in potassium (for nerve nutrient) and magnesium (which is essential for calcium utilisation). (HP-13)

Insight/awareness work and inserting a new, healthier habit or routine. (HP-4)

Eat well, drink plenty of milk. (HP-7)

Drink plenty of milk and eat well. (HP-9)

Encourage them to eat wide range of food, eat more banana, chia seeds, nuts, seaweed, and seafood. (HP-10)

Eat or drink more calcium, magnesium and silica in diet which will help grow nails and repair them. …Milk, bananas and chia seeds are rich in these nutrients. (HP-11)

5.4.4.4 Early intervention and individualised treatment

'It is sooner than later' is the motto generally adopted in health treatment and advice. Data from the interviews with health professionals seemed to consolidate this point. Most of them expressed the emphasis on early treatment for nail biting as pathology, starting as early as possible. While "nail biting is usually initiated in childhood" (PH-8), treatment was advised to start at that stage. As HP-3 stressed, "It is important to treat nail biting and take it seriously." Others tended to agree with his point.

Treating nail biting in children is much simpler than the adult. Adult is more complicated. Adult often require extra B-complex with the above minerals if they are experiencing high stress or anxiety level. If the habit is too strong and stubborn, high dose of Inositol is often useful to tackle the compulsive habit. (HP-2)

Treating nail biting in children is easier than adults as adult tend to progress to stubborn habit or OCD which is much harder to stop. (HP-7)

In addition, treatment was thought to be best on a case-by-case basis. This was because different causes of nail biting would dictate the employment of different treatment methods. HP-2 provided a clarification on this point, "It is important to

identify the root cause of nail biting such as nutritional deficiency alone or is it combination of both the compulsive habit and nutritional deficiency; or is it only the habit left?" That was the reason why many health professionals recommended an individualized approach to treatment of nail biting to maximise success.

> *Treating nail biting is quite challenging, some nail-biters require habit removal therapy alone (such as bitter nail polish), some require mineral supplement only and others may require both. (HP-9)*

> *Treating nail biting is individual. Nail diagnosis and RBC analysis are very important to identify the deficiency mineral. (HP-5)*

5.5 Nail biters' perspective

In addition to the views from health professionals, the study gathered qualitative data from nail biters and parents of nail biters regarding the possible causes, related health problems, and utilised treatment for nail biting. Their inputs to this study were valuable, especially when they shared their stories and experiences from a patient point of view.

5.5.1 Reasons for nail biting: The patients' perspective

The common view among the participating nail biters and parents of nail biters was that it was important to know the main causes nail biting; otherwise, it was impossible to develop any treatment. This view is clearly expressed in the following quote.

> *Really want to know the cause of nail biting so it can help my child stop biting her nails… It would be good to know more about the initial cause of the nail biting, so it can be prevented. (NBS-17)*

However, different views on the reasons for nail biting were offered. From the responses of the participants, the causes of nail biting were not restricted to a list of easily defined elements. Nail biting sometimes was not caused any of the widely documented factors. It could just be the result of an incidental behaviour which

later on habitually turned into chronic nail biting. A past nail biter reflected on what led to the development of her nail biting habit.

> *As a former nail biter of fifty years, I can tell you that it started when I was three after someone painted my nails bright red. As soon as the polish chipped, I tried to remove it. Teeth were the best tool. After that, I bit my nails. Saliva breaks. (NBS-13)*

Diverse as they were reported to be, the perceived causes of nail biting fell into two main categories of emotion and diet. In addition, the participating nail biters and parents of nail biters tended to sound more tentative than the health professionals when talking about these possible causes.

5.5.1.1 Emotion

The majority of responses from nail biters and parents of nail biters indicated nail biting habit as generally being caused by anxiety and/or stress although they also believed that nail biting could be caused by other underlying causes. In fact, psychological conditions were seen as a contributing factor for nail biting, as one participant stated, “It could be anything but I find myself bite my nails more often when I am depressed.” (NB-9), or “when I was stressed, anxious and depressed” (NB-18). Their feedback was clearly indicative of the association between one’s psychological or emotional condition and nail biting. In addition, they reported biting nails when they were doing something that required a high level of concentration, such as watching TV or studying. However, they did not clearly point out whether it was a causal relationship or just some co-occurring symptoms. The following comments illustrate this point.

> *When I am anxious, angry and thinking. (NB-17)*

> *When I am hungry, angry, stressed, watch TV etc. (NB-3)*

> *Stress, nervous, and also boredom. (PNB-3)*

> *When she is stressed and study. (PNB-4)*

Could be anything such as bored, watch TV etc. (NB-9)

Usually I was not fully conscious of the behaviour. Could be anything but I tend to bite more when I am depressed. (NB-15)

When I was thinking, angry, stressed and depressed. (NB-16)

When I feel depressed I tend to bite my nails more often. To relief depressed mood, I go for a walk then I feel better and I bite my nails less. (NBS-64)

When he was studying or watching TV. (PNB-1)

5.5.1.2 Diet

In addition to emotional states, the stories shared by nail biters and parents of nail biters also suggested a possible link between nail biting and unbalanced diet or nutritional deficiency. Milk was frequently mentioned as the key component of a healthy diet, which was often absent in the participants' daily intake. As a nail biter admitted, "The only thing I don't like is milk. It makes me sick." (NB-5) Others shared a similar diet with a lack of milk in the following comments.

I think it became a habit for the most part but interestingly nail biting stopped around the same time as I started taking iron supplements; and being strict with nail care, cutting/filing my nails. (NBS-1)

He does not like milk and dairy products. Otherwise, he eats almost everything. (PNB-1)

I don't like milk much. I only put a little bit in my coffee. (NB-2)

I used to drink very little of milk a day and I hardly eat banana. (NB-7)

I hardly drink any milk. The only time I have milk is in my coffee sometimes. (NB-8)

Somehow, he is not a big fan of milk. (PNB-2)

Meat was another food group that was frequently reported to be missing in the nail biters' diet. The comments bellows illustrate this point.

> *I used to not like eating meat, most vegies. (NB-10)*
>
> *He was a fussy eater. He ate very little of meat. (PNB-3)*
>
> *She is a fussy eater. She doesn't like eat meat (especially red meat). I try to push her to eat meat but she can only manage to eat a little bit. She hardly drinks milk and eat banana. (PNB-4)*
>
> *I generally eat meat about once a week. I don't like much of red meat. (NB-14)*

5.5.2 Nail biting and associated health issues/symptoms

In addition to explaining the causes of nail biting, the participating nail biters and parents of nail biters referred to other health problems that they were suffering. Those issues included, for instance, poor circulation (NB-6), asthma, poor appetite, teeth grinding during sleep (NB-12), fatigue (NB-11), frequent chest infection (PNB-4), hypothyroidism (NB-15), recurring boils, high blood pressure and cholesterol (NB-16), skin rash and tiredness (NB-14), just to name a few. Generally, the most common sub-themes of those health issues include psychological disorders, muscle cramp and joint pain, nutritional deficiency, and digestive system disorder.

5.5.2.1 Psychological disorders

It was revealed from the stories of the nail biters and parents of nail biters that most of them were suffering from some type of psychological disorder. Especially, those psychological problems were clearly felt by the nail biters, with some being diagnosed by a specialist. The most frequently mentioned psychological problems were stress, anxiety and depression. The following quotes provide evidence for the existence of those disorders among many participating nail biters.

> *I have frequent mild anxiety attacks but I don't want to take medication for it… Actually, I don't sleep well. I find it hard to fall sleep. (NB-2)*

Tiredness, skin rash, anxiety and depressive moods. (NB-14)

I have been diagnosed with anxiety and depression… I have frequent depressive moods... (NB-3)

ADHD (attention deficit hyperactivity disorder) and oppositional defiant disorder… Anxiety and feeling depressed sometimes. (NB-8)

… Depressed moods and anxiety attacks. (NB-12)

5.5.2.2 Muscle cramp and joint pain

As expressed by some nail biting participants, they also experienced various types of pain and ache. Joint pain, stomach pain, muscle pain and throat infection were most frequently mentioned as co-occurring problems of nail biting. It was not clear from the data as to how they were possibly linked, but these first-hand experiences from the nail biters would warrant further attention and examination from health professionals with an interest in this habitual disorder. Some comments from the nail biters are presented below.

Joint pain, stomach pain and an annoying hissing sound in both ears. (NB-1)

Muscular/joint pain and frequent ear, nose and throat infection. (NB-7)

Frequent eyes twitching, sore throats, aches and pain in both legs. (PNB-1)

5.5.2.3 Vitamin and mineral deficiency

The third type of health issue experienced by nail biters was nutritional deficiency, with vitamin and mineral deficiency being the most frequently mentioned. Nutritional deficiency was also thought to be a possible cause of nail biting by some participants. Specifically, Vitamin D and iron deficiency were mentioned by many nail biters. More details about their nutritional deficiency can be found in the following comments.

Vitamin D deficiency. I have been taking Vitamin D supplement for 1 month. Today, the doctor suspect me being anaemic hence he sent me to have a blood test for Iron level. (NB-14)

I have Anaemic of Iron deficiency. (PNB-3)

I just came back from the doctor today and he told me that my daughter recent blood test result indicate iron deficiency. She is not severely iron deficiency, just at the borderline of low iron. He recommended her to take Iron supplement. (PNB-4)

5.5.2.4 Digestive system disorders

Other health issue reported by the participating nail biters that might be associated with nail biting was digestive system disorder. Constipation (NB-7) and gastric disorder (NB-6), for example, were typical issues of some nail biters. Similar disorders included coeliac, frequent stomach bloating and pain (NB-6), lactose intolerance, tonsillitis and growing pain (NB-3), cold sensitive, irritable, recurring styes, (NB-7), and Crohn's disease (NB-13).

5.5.3 Commencement of nail biting habit

As indicated by the majority of the participating nail biters and parents of nail biters, nail biting habit started during childhood. For some nail biters, this habit started to develop as early as 3 years old. For others, they were too young to remember the exact age when nail biting habit commenced. The following comments provide details on this point.

I was too young to remember but my mum told me that I started nail biting when I was around 3 years old. (NB-1)

I was a child when I had the nail biting habit so I couldn't remember how I felt. (NB-3)

I bit my nails since I was a very young child hence I would not know how I felt back then. (NB-6)

Could not remember! I started biting my fingernails when I was very young. (NB-12)

I am usually not fully conscious of the behaviour. I started biting when I was very little hence I don't know how I felt back then. (NB-15)

5.5.4 Types of treatment received

While discussing the treatment received for nail biting, most of the participating nail biters indicated that it was "a stubborn habit and require lots of will power" (NB-2). One nail biter reflected on her initial failures to stop biting nails with frustration.

I was keen to try anything but the urge was too strong. I try so hard to stop my nail biting habit so I can grow the nails, but I compulsively bite them off, I have this "perfect" obsession that I can't get it out of my mind. I compulsively keep my nails straight, I hate chips or kinks in them, it gets to the point I rip them off in anger. (NB-1)

It was felt that self-initiated treatment didn't work, and the majority reported to receive help and support from others, such as their parents and health professionals. Some nail biters even used different treatment methods to enhance the likelihood of success. For example, one nail biter reported, "I tried bitter nail polish, listened to a nail biting Hypnosis CD, punishment such as rubber band and psychotherapy." (NB-1)

As a whole, the treatment received by the participating nail biters could be grouped into cognitive behavioural therapy, and supplement and medication.

5.5.4.1 Cognitive-behavioural therapy

As indicated in the interview data, the majority of the treatment methods received by nail biters were related to cognitive-behavioural therapy or psychotherapy. This treatment method aims to make modifications to the thoughts and behaviours of nail biters, redirecting them to other substitute actions. Specifically, they were

treated with aversion therapy, habit reversal training, hypnosis, reminders, and punishment.

Aversion therapy is a cognitive behavioural treatment that aims to turn nail biting into an unpleasant experience for nail biters. However, from the first-hand experience of the nail biters, bitter nail polish could work as a nail biting deterrent only for a short time. Once they were familiar with the bitter taste, the habit would come back. This point is clearly illustrated by the following comments.

> *Bitter nail polish- it only works for a few days but then I get used to the bitter taste. (NB-18)*

> *Bitter nail polish was the first therapy that my parents tried on me when I was young. It was recommended by a pharmacist. It only works for me for 2 weeks then relapse. The relapse was due to the urge of biting was much stronger than the avoidance of terrible taste. (NB-16)*

> *My parents tried to stop me biting. They painted the horrible bitter nail polish on my fingernails. They tried rewards and taping my fingernails up. (NB-6)*

> *The bitter nail polish worked only for a couple of day till I got used to the taste. (NB-13)*

Reminders were also received by some nail biters to stop this habitual disorder. According to these nail biters, their parents would usually be their reminders to stop biting nails on the spot. However, it was felt that this method was effective only in the presence of their parents. Some typical stories are presented below.

> *They tried to tell me to stop every time they saw me biting my nails. I got very annoyed (NB-1)*

> *Whenever I saw him biting his nails, I yelled out "not in the mouth" he immediately stop biting for a few minutes then he slipped the fingers back to his mouth again. (PNB-1)*

In addition, minor punishment, such as smacking or using rubber band, was mentioned as a method employed some nail biters themselves or their parents to correct this habit. As a nail biter reminisced, “When I was young, my parents used to smack my fingers when they saw me biting my nails” (NB-4). Nevertheless, their comments were indicative of the lack of effectiveness of this treatment. The main problem seemed to be the relapsing of nail biting upon the removal of such punishment. Some typical stories are as follows.

> *They smacked my hands when they saw me biting my nails… They tried to stop me for a while but gave up because I got aggressive and annoyed when they told me to. (NB-15)*
>
> *My parents smacked my hands or mouth to stop me from nail biting. They plastered up all my nails with tapes or band aids. However, the urge is too strong and I ripped them off. (NB-2)*
>
> *I put band aids on his fingernails. I praised him when he was not biting. I made him to wear a rubber band on his wrist to snap every time he caught himself biting them. (PNB-2)*
>
> *I tried the rubber band method as suggested by friends. I put a rubber band on my wrist, and when I found myself biting, I snapped it. I have to snap it hard enough to hurt to remind me stop biting. Within a week my nail biting was cut down to almost nothing. Every so often I find myself relapsing and then I put the rubber band back on for a few days then stop. However, this method only work for a while then the urge is too strong to resist. (NB-16)*

As another type of cognitive behavioural therapy, habit reversal method was employed by some nail biters. The mentioned techniques were squeezing a stress ball or playing with a ring, which was meant to distract nail biters from their nail biting habit. While the former technique was thought to be ineffective and impractical, the latter worked quite well for the participants. The remarks below demonstrate this point.

I also tried to squeeze on a stress ball instead of biting. It is unpractical because I didn't carry the ball with me all the time. (NB-2)

Playing with a ring to distract myself from biting is a substitute habit I tried on and off. I wore an orange ring, working pretty well for a while. (NB-3)

Hypnosis was the last type of cognitive behavioural therapy mentioned by the nail biting participating, which reportedly worked well in combination with other methods. As indicated by NB-13,

I need to listen to the hypnosis audio every day for 3 months and then when I required. He also advised that if stress or excessive worry sometimes bring the nail biting habit back, I must recognize and try to resolve the problem otherwise hypnosis alone will not be effective… Hypnosis worked very well for me. (NB-13)

5.5.4.2 Supplement and medication therapy

The second category of treatment methods received by the participating nail biters was supplement and medication therapy. Especially, for those nail biters who were diagnosed by a health professional with nutritional deficiency, psychological disorders, or other clinical symptoms, they reported the use of this method more frequently. According to NB-7, for example, mineral supplement not only treated nail biting habit, but also seemed to cure all of his related health problems.

I used to have problems with eyes twitching, poor appetite, frequent muscle cramps, frequent ear, nose and throat infections and enlarged tonsils. However, all of these complaints suddenly resolved after taking the above [Schuessler Tissue salts] mineral supplement. (NB-7)

For some cases, supplements and medication had limited effect, as indicated in the following comments.

My GP prescribed me an antidepressant (Zoloft) to control my anxiety and depression. Zoloft seemed to control my nail biting habit for the first few

months and then became ineffective afterward. Although my anxiety and depression have improved with Zoloft but I still cannot stop nail biting. (NB-14)

Multi-Vitamins were recommended by the Internet. I took a general Multi-Vitamin for 2 months but it didn't do anything. It didn't improve my nail biting or any other health complaints. (NB-16)

For most cases, on the other hand, supplements and medication were reported to bring about excellent results. As recalled by a parent of a nail biter, only the use of mineral and Vitamin D supplements could help control the habit while various other methods were tried with failure. "I put band aids on his fingernails. I praised him when he was not biting. I made him to wear a rubber band on his wrist to snap every time he caught himself biting them. I painted the gross bitter nail polish on his fingers. None of those interventions work until he took the Celloid mineral supplement and Vitamin D." (PNB-2) Similar stories about the effectiveness of supplements and medication in the treatment of nail biting are presented below.

Recently I am taking N-Acetylcysteine and this helps a lot. After biting my nails all my life, I would say about over 50 years. Now I have almost stopped. I have almost no urge to bite my nails any more. I have been taking NAC at 800mg per day for the last 3 months and have had a big improvement in my health. The tinnitus is reduced by about half with fewer episodes with loud and varied noises. My muscle pain has improved and I feel more vitality. The urge to bite my nails has tremendously reduced by 98%. I started noticing my nails grow long after 3 weeks of taking the supplement. (NB-1)

I gave him Schuessler Tissue salts Kidz Strong bones and Teeth which contain tiny dose of calcium phosphate, Calc Fluor, Magnesium phosphate & Silica. He stopped nail biting within a week after commencing the Tissue Salts. The pharmacist then added on to the therapy with extra Calcium and Vitamin D supplement. (PNB-1)

It is worth noting from the responses of many participating nail biters that supplements and medication were sometimes used to treat other health issues, but then contributed to eliminate nail biting habit. This positive by-effect of supplements and medication were so frequently mentioned by the participants that it warranted further attention and research. Specifically, those supplements or medication included Vital-Greens, thyroid replacement drug (Oroxine), vitamin D, Celloid silica, calcium and magnesium supplement, Intestinal Freedom and the Wormwood Plus tincture, and Diatomaceous Earth (DE). The following quotes provide further details about each case.

> *After taking the Vital-Greens and started on gluten free diet, I suddenly stopped nail biting. I was amazed, as I was not even trying to stop the habit. I noticed that when I forgot to take my Vital-Greens or eat something with gluten, I will start biting my nails again (NB-14).*
>
> *I was lethargic and suffered many other symptoms and I was getting worse. I went to see my GP to treat those symptoms but I did not mention anything about my nail biting to the doctor. I was diagnosed with borderline low thyroid. I was started on thyroid replacement drug (Oroxine) and within 2 weeks of starting the medication, the compulsive nail biting urge just disappeared. It has been more than 1 year that I have not biting my nails since I started taking the Oroxine. Oroxine cured my compulsive nail biting. (NB-15)*
>
> *I suddenly stopped nail biting within 1 week by chance after taking vitamin D, Celloid silica, calcium and magnesium supplement for something else. I found the naturopath's recommendation was very effective. (NB-19)*
>
> *I found the Intestinal Freedom and the Wormwood Plus tincture and this work really well. After 30 days of taking the parasites treatment, I completely stopped biting my nails… I noticed that I stop biting my nails on the 3rd day. My energy level was increased after the parasites detox. Also I slept much better at night. Only the parasites detox helps to clear out the root cause of my nail biting. It has been 5 years now that I haven't bitten my*

nails. I found all other methods that I tried such as "bitter nail polish", wearing rubber band on the wrist and playing with the ring can only help to distract the urge but does not fix the underlying cause of my nail biting. (NB-3)

I didn't know that Diatomaceous Earth (DE) would help my nail biting. Initially, I ordered it for my chicken to kill mites. The package arrived with some information about the DE. It explained that DE contains very high in silicon dioxide and more than 15 essential minerals including calcium, magnesium, potassium, zinc, iron, copper, selenium and phosphorous, sodium; When taken orally by humans and animals, DE will improve many health complaints and vitality… I took 2 tablespoon of DE daily in a cup of juice or water. About 4 weeks after taking DE, my hair has stopped falling out and my skin are so much better, smooth and radiance. I also noticed my nails were long and strong- first time in so many years that I actually have fingernails! The strong urge to bite was gone forever. Since I have been on DE, I stopped nail biting without any relapse for more than 6 years now. …Diatomaceous Earth was the only long-term effective treatment for me. The other methods did not work in the long term. (NB-16)

5.5.5 Assistance seeking

Regarding their assistance seeking, the majority of the participants reported they normally sought help from medical doctors, friends, pharmacists, naturopath/kineosiologists, hypnotherapist, and online resources (NB-7, NB-11). As a nail biter commented, "The doctor advised that "just let go and not to be worried. It will eventually go away." The pharmacist recommended the horrible bitter nail polish. Friends recommended the rubber band method and Hypnosis. The internet recommended N-acetylcysteine." (NB-1)

Many of them expressed their appreciation for health professionals who were "very useful and effective in eliminating my health issues and nail biting" (NB-1).

I found the supplement that the naturopath recommended was very effective. Within 3 days of taking the supplement, his nail biting was amazingly less. About 3 weeks of the supplement, his fingernails were pretty long and he completely stopped the biting habit. (PNB-2)

5.6 Summary of the qualitative findings

The results of the analysis focused on two perspectives: health professionals and nail biters (and their parents). From the perspective of the professional health workers, there were different views on the possible causes, and methods of diagnosis and treatments for nail biting. Thus, a range of different causes and treatments were canvased. No participants exclusively attributed any single cause to nail biting, but tended to link nail biting to a variety of contributing factors. According to the qualitative data analysis, the causes of nail biting were assigned to two main sub-themes: psychological and nutritional or physiological factors. The former involves anxiety and stress while the latter covers mineral or vitamin deficiency, diet/malnutrition, thyroid disorders, and parasites.

As their views about the primary cause of nail biting were inclusive, the health professionals indicated a wide range of different diagnostic approaches. They had a tendency to utilise a combination of diagnostic approaches, rather than relying on one single approach. They recommended a range of treatments related to cognitive-behavioural therapy, particularly when psychological factors (e.g., anxiety, or stress) were identified as a cause or being closely associated with nail biting. In addition they noted that treatment of nail biting needed to take those into account possible causes of nail biting with the use of supplements or medication. Finally, the analysis placed their advices under emerging themes such as awareness, health screening, healthy diet, and early intervention.

From the perspective of nail biters and their parents, the analysis dealt with the possible causes, related health problems, and utilised treatment for nail biting. They indicated that it was important to know the main causes nail biting and offered different views on the reasons for nail biting. For them, anxiety and/or stress were

involved in the cause as psychological condition was seen as a contributing factor. They also suggested a possible link between nail biting and unbalanced diet or nutritional deficiency. Milk was frequently mentioned.

In addition, associated health issues were mentioned such as poor circulation, asthma, poor appetite, teeth grinding during sleep, fatigue, frequent chest infection, hypothyroidism, recurring boils, high blood pressure and cholesterol, skin rash and tiredness. Digestive system disorders were also seen as associated with nail biting, such as constipation and gastric disorder, frequent stomach bloating and pain, lactose intolerance, tonsillitis and growing pain, cold sensitive, irritable, recurring styes, and Crohn's disease.

In relation to types of treatment received, most of the participating nail biters admitted that it was hard to reform. One nail biter reflected on her initial failures to stop biting nails with frustration. According them, self-initiated treatment was a big challenge, thus they needed help and support from others, such as their parents and health professionals. The treatment methods received by nail biters were related to cognitive-behavioural therapy or psychotherapy. The second category of treatment methods received by the participating nail biters was supplement and medication therapy. For some cases, supplements and medication had limited effect, whereas for most other cases supplements and medication. Regarding their assistance seeking, the majority of the participants normally sought help from medical doctors, friends, pharmacists, naturopath/kineosiologists, hypnotherapist, and online resources.

5.7 Conclusion

This chapter has presented the qualitative findings from two sources: the interview data with the health professionals, nail biters and parents of nail biters; and the written responses from the open question of the two survey questionnaires. A number of key themes and sub-themes were identified, which revealed the underlying causes of nail biting, related health issues and possible treatments. It was observed that there was a convergence of themes and sub-themes, which

emerged from the two main groups of participants. The main causes of nail biting fell into main categories of psychological factors and nutritional deficiency. Related health problems included psychological disorders, muscle cramp and joint pain, vitamin and mineral deficiency, and digestive system disorders. The recommended treatments were either a type of cognitive behavioural therapy or supplement and medication therapy.

The next chapter will discuss the findings from chapter four and five and will provide a number of comparisons between the views and insights of health professionals, of nail biters and the quantitative data analysis from the two survey questionnaires. This discussion will provide an overarching understanding to answer the research questions which relate to determining the possible causes of nail biting, associated health issues and treatment of nail biting. In addition, the chapter will provide implications and recommendations for parents and health professionals in dealing with nail biting problem.

6 Discussion and Conclusion

6.1 Introduction

The previous two chapters detailed the quantitative and qualitative data analysis. This chapter seeks to discuss these findings in relation to the research questions, which were related to the perceived causes of nail biting, associated health issues and possible treatment of nail biting, from the perspectives of nail biters, parents of nail biting children, and health professionals. The discussion also considers how the study's findings are related to the existing body of knowledge in the literature. Based on this discussion of findings, the chapter then outlines some practical recommendations for various parties. It also points out the strengths and weaknesses of the study and highlights future research directions for researchers with a similar interest in nail biting. Finally, the researcher's reflection on her PhD research journey will be presented to provide some insights into the personal interests and development of the researcher which have motivated the researcher to embark on this doctoral journey. As research is primarily a human activity which explicitly or implicitly reflects and influenced by the background of the researcher, the first person (I, me) will be purposely used in this reflective section.

6.2 Perceived causes of nail biting

In relation to the research question about possible causes of nail biting, the study has given some insights from the varied perspectives of nail biters, parents of nail biting children, and health professionals. The opinions from these participant groups were compared and contrasted to provide a synthesised multi-perspective discussion in the studied issue.

6.2.1 Psychological imbalances: Top perceived cause of nail biting

The most consistent finding was the consensus among the different groups of participants in that psychological imbalances, such as stress, anxiety and nervousness, were the principal cause of nail biting. Specifically, on the part of nail biters and parents of nail biting children, the quantitative results showed that psychological imbalances were believed by nearly half of the respondents (48.0%) to be mainly responsible for the development of nail biting habit. The quantitative results from the survey for health professional showed similar belief, with a large majority of 85.0% of the health professional respondents principally attributed nail biting to psychological imbalances.

Qualitative findings from the interviews with nail biters, parents of nail biting children and health professionals contributed to further elaborate and consolidate their strong belief in the causal relationship between psychological imbalances and nail biting. The majority of responses from nail biters and parents of nail biting children indicated nail biting habit as a consequence of anxiety, stress, and/or a high level of concentration. Their feedback was clearly indicative of the association between one's psychological or emotional condition and nail biting. Likewise, there was a strong indication in the comments of the health professionals that nail biting was generally caused by psychological factors such as anxiety, stress, and nervousness. A recurring theme highlighted by the health professionals was that a disturbance to or instability in emotional and psychological states could result in nail biting habit in the patient. They even provided an explanation for the association between the two, describing nail biting as an attempt to cope and regain balance. It is worth noting that the health professionals tended to speak with absolute certainty regarding this causal link between anxiety and nail biting.

This outstanding finding of the study is strongly supported by previous research in the field. In fact, many researchers have referred to psychological and psychiatric issues while explaining the cause of this habitual disorder and nail biting is suggested to be reflective of underlying psychopathology (Dufrene et al., 2008). The

etiological factors for nail biting, which are pertinent to psychological imbalances or emotional disturbances, as reported in a body of research are anxiety, stress, tension, loneliness, and inactivity (Deardoff et al., 1974; Tanaka et al., 2008). Situations that trigger fear, boredom, or pain are also associated with fingernail biting (Doctor, 2000). As an explanation for their relationship, early researchers also considered nail biting as a stress-relieving oral habit (Foster, 1998; Sachan & Chaturvedi, 2012; Woods et al., 2001).

The finding of this study, along with similar research evidence in the field, showed that the casual relationship between psychological imbalances and development of nail biting habit was strongly grounded. In other word, it has substantiated proof that psychological factors had a key role in the development of nail biting habit. Therefore, it is highly recommended that randomised controlled studies be conducted for potential treatments. In addition, more research is needed regarding the questions of how these psychological factors trigger nail biting in the first place and how nail biting acts to regain balance in psychological states. Findings from these studies will pave the way for more effective treatment method for pathologic nail biting.

6.2.2 Nutritional deficiency: Second candidate for causing nail biting

As revealed by the study's findings, nutritional deficiency, which is closely linked to mineral deficiency or poor diet, was the second prevalent factor considered to be the main cause of nail biting. As for the nail biters and parents of nail biting children, the survey results showed that more than one third of the participants attributed nail biting to mineral deficiency (38.0%), and poor diet (36.0%). To reinforce this, the inferential statistics showed that there was a significant association between frequencies of nail biting and poor diet. Similarly, interview data also included stories shared by nail biters and parents of nail biting children about a possible link between this oral habit and unbalanced diet or nutritional deficiency. For example, milk was frequently mentioned as the key component of a

healthy diet, which was often absent in the participants' daily intake. Many children did not meet the NHMRC recommended milk intake for their age (NHMRC, 2013).

It was interesting to note similar findings on the part of health professionals. In their views, poor diet came second in the list of main causes of nail biting, being mentioned by more than a half (51.0%) of the health professionals. In addition, nearly half (49.0%) believed that mineral deficiency had a causal relationship with nail biting. Data from the interviews supported this finding when most participants stressed with a high level of confidence that mineral deficiency was an important contributing factor. The specific minerals included calcium, silica, magnesium, potassium, and zinc, whose shortages were thought to be mainly responsible for triggering nail biting.

This finding of the study is consistent with a large body of previous research studies, especially those in alternative or complementary medicines, which have concluded that mineral deficiency causes individuals to engage in nail biting behaviour to ameliorate their mineral status (Jones, 2011; Kingsley et al., 2005; Odey, 2011; Whitcroft, 2009). It is widely believed that because the mineral components of nails include dominantly calcium, magnesium, potassium, zinc, iron and sodium (Ohgitani et al., 2005; Whitcroft, 2009), nail biting may be indicative of a deficiency in calcium, magnesium, other minerals (Jones, 2011; Kingsley et al., 2005; Odey, 2011; Whitcroft, 2009) and zinc (Atlantapostpolio, 2012). It is hypothesised that the body unconsciously attempts to replenish those deficient minerals through nail biting (Odey, 2011), consequently establishing a stubborn habit (Jones, 2011) or in severe cases, a compulsive disorder (Tanaka et al., 2008).

To confirm these beliefs epidemiological studies are needed to establish if there is an association. Randomised controlled trials of various nutrient supplements would establish a therapeutic effect of supplements.

6.2.3 Multidimensional aetiology of nail biting

Although one or two factors (such as psychological imbalances and nutritional deficiency) were more prevalent than others as the perceived causes of nail biting,

there was a general agreement among the participants that nail biting was multifactorial in origin. Participants strongly felt that no single factor could be used to fully explain the development of nail biting habit. This multidimensional aetiology of nail biting probably makes it more difficult for health professionals to diagnose the root cause(s) for efficient treatment. Combined therapies may be needed to improve successful outcome rates.

Data from the interviews with health professionals contributed to confirming the multidimensional nature of nail biting aetiology with some snapshots of their diagnostic practices. As reported, the health professionals tended to utilise a combination of diagnostic approaches, rather than relying on one single approach. The development of a standardised approach to diagnosis is needed prior to any therapeutic studies. Many recommended the use of the survey questionnaire used in this study to identify various related clinical and nutritional issues. One reason for this recommendation is because health professionals are aware that nail biting could be caused by a wide range of factors.

6.3 Common health risks associated with nail biting

6.3.1 Infectious diseases: Top associated health risks

Infectious or transmissible diseases are illness resulting from infections. By definition, infection refers to the invasion of disease-causing agents to an organism's body tissues, and the reaction of host tissues to these organisms (medical dictionary). Infections are caused by infectious agents, including viruses, viroids, bacteria, parasites and nematodes (e.g., worms), arthropods (e.g., ticks, mites), and fungi.

The findings showed that infectious diseases were the most prevalent health problems associated with nail biting, as revealed by nail biters, parents of nail biting children, and health professionals from their live experiences. To be more specific, it was found that cold and flu, which are caused by viruses, were the most common past health issue of a high percentage of nail biters (71.0%) which was higher than the national average rate of Australians who had cold and flu (62.0%) (Department

of Health, 2015). Importantly, the quantitative data analysis showed that there was a significant association between frequency of nail biting and incidence of cold sores, which helped substantiate the evidence for their link. In addition, more than half of the nail biters also reported suffering from different types of infections (51.0%) and inflammations (i.e., their body reactions' to inflections) (53.0%). An unexpected finding was high incidence of joint pain reported by nail biters. Again, the data analysis showed that there was a significant association between frequency of nail biting and joint pain diagnosed by doctors. It is feasible that this may represent an increased incidence of viral illness acquired from nail biting with associated arthritis The stories shared from the interviews with the nail biters consolidated this finding with reported incidents of various types of pain and ache, such as joint pain, stomach pain, and throat infection. It was not clear from the data as to how they were possibly linked, but these first-hand experiences from the nail biters would warrant further attention and examination.

The results from nail biters were corroborated by those from health professionals, highlighting infectious diseases as the top health risks associated with nail biting. As reported by the highest proportion of 60.0% of the health professionals, the most prevalent health issue among nail biter patients was the existence of parasites/worms. Additionally, bacterial/viral infections and jaw joint pain were also very popular, with 46.0% and 37.0% of the health professionals reporting to diagnose them among their nail biting patients. Importantly, the quantitative data analysis showed that there was a significant association between frequency of nail biting and incidence of infections as well as between frequency of nail biting and the existence of parasites or worms.

These findings of the study appear to establish the association between nail biting and infectious diseases, which are strongly supported by the literature. For example, according to Tosti and colleagues (1994), germs and worms are common health issues of nail biters due to the fact that hands and fingernails come into contact with untold numbers of germs each day. Nail biting can result in the transfer of germs such as cold and flu viruses, bacteria and parasite eggs from the hands to the mouth, which can lead to serious illnesses (Creath et al., 1995). One

assumes that the carriage of many viruses resulting in point pain or intestinal infections is also confirmed by many researchers (Escobedo et al., 2008; Kamal & Bernard, 2015; Saheeb, 2005). It is a normal practice that hand washing prior to eating is protective against cold and influenza. However, one would expect that nail biting would negate this protection. Furthermore, hygienic measures such as hand washing could reduce the spread of respiratory viral infections (Jefferson et al., 2001).

One possible explanation for the prevalence of infectious diseases among nail biters was the constant exposure of finger nails to various types of infectious agents, such as bacteria, viruses, fungi, or parasite eggs. These infectious agents can easily invade the body of nail biters through contact with their mouths. Therefore, nail biters and parents of nail biting children should be made clearly aware of these health risks, which could lead to more serious illness and consequences.

6.3.2 Dental issues and other related health problems

Dental issues as reported by nail biters, parents of nail biting children and health professionals in the study included various problems to the teeth and the gum. According to the survey results, nearly half (43.0%) of the nail biters experienced dental issues. Similarly, many health professionals (38.0%) reported incidences of gingivitis or confections to the gum among their nail biting patients. Other health issues reported by nail biters in the interviews were related to digestive problems and psychological or behavioural disorders. Their stories were supported by findings from the health professionals, with 29.0% recording diarrhoea, and about half recording either ADHD, bed-wetting or depression, among their nail biting patients.

These findings were not new to the literature. In fact, many researchers have reported dental issues, such as chronic swollen gums (Hodges et al., 1994), alveolar destruction in the area of the involved teeth (Hideharu & Jenji, 2003), or gingivinal injuries (Krejci, 2000; Shetty & Munshi, 1998). The most probable explanation for this relationship is probably the continuous forces of excessive nail biting on the teeth and the gum.

6.4 Treatments for nail biting

While nail biters and health professionals tended to be in agreement regarding their perceived causes of nail biting and associated health issues, there were both common and different opinions regarding the treatments for nail biting. The treatment methods that nail biters, parents of nail biting children and health professionals favoured were bitter nail polish and mineral supplements; however, they were divided regarding the use of punishment and hypnosis. Other treatment methods mentioned by a negligible proportion of the participants included medication, other psychotherapy methods, the use of fake nails, Thyroxine, Pedisure formula, ceasing drinking coffee, will power, and gluten free diet.

6.4.1 Bitter nail polish: Fast but short-term effect

As indicated by the findings from the survey, more than half of the nail biters (53.0%) utilised bitter nail polish as a treatment for nail biting; and many (39.0%) believed that this treatment was effective. Similarly, the majority of the health professionals (80.0%) would recommend the use of bitter nail polish as a treatment method for nail biting. In addition, the data analysis showed that there was a significant association between health professions and views about whether or not bitter nail polish would be used for nail biting treatment. The analysis result indicated that bitter nail polish was significantly favourable for nail biting treatment by medical doctors and pharmacists compared to naturopaths and others health professional group. This opinion is in conflict with the results of RCT bitter nail polish in the treatment of nail biting (Silber and Haynes, 1992).

The interview data provided further understanding on how effective this method was from the perspective of the nail biters. Specifically, bitter nail polish, a type of aversion therapy, would work as a deterrent, but only for a short time. According to them, the initial unpleasant experience introduced by bitter nail polish wore off as they got used to it, and the habit came back.

Previous researchers tend to support the use of similar aversion to treat nail biting. Silber and Haynes (1992) or Allen (1996), for example, promoted the use of mild

aversion with the use of bitter nail paint with evidence of significant improvements in nail length. All of the findings related to the use of bitter nail polish suggested that although it can be an advisable choice for nail biters with its visible and quick effect, bitter nail polish, and other similar aversion therapy, might not be the best therapy in the long term.

6.4.2 Mineral supplements: Far-reaching effects

The survey results showed that about one third (34.0%) of the nail biters reported the use of mineral supplements as a treatment for nail biting. Regarding their effectiveness, interview data revealed this treatment method as being highly effective and far-reaching. For example, their stories showed that mineral supplement not only treated nail biting habit, but also seemed to cure other health problems. Importantly, this treatment could help control the habit while various other methods were tried with failure. This positive experience from the nail biters about the effects of mineral supplement was in alignment with health professionals'. Particularly, nearly half of them (42.0%) suggested the use of mineral supplements to control nail biting habit. This finding is supported by the literature, with many researchers proposing the use of appropriate deficiency minerals to break the nail biting habit (Jones, 2011; Kingsley et al., 2005; Odey, 2011; Whitcroft, 2009).

6.4.3 Punishment and hypnosis: Different opinions

While they tended to have similar preference for bitter nail polish and mineral supplements, nail biters and health professionals expressed quite different views on the use of punishment and hypnosis. For example, punishment was recommended by only about 2.0% for the health professionals, but it was used by about one third (30.0%) of the nail biters. To be more specific, they reported using minor punishment, such as smacking or using rubber band, sometimes with the assistance of their parents to correct this habit. Nevertheless, their comments were indicative of the short-term effectiveness of this treatment. The relapsing of nail biting upon the removal of such punishment seemed to the main problem.

Likewise, about one third of the health professionals were in favour of hypnosis, thus recommending it as an effective treatment for nail biting. However, less than one tenth of the nail biters employed hypnosis treatment, and few positive comments were made on their part.

These two recommended treatment methods have also been documented and proposed by some previous researchers. For example, Bucher (1986) reported the use of a shock device and snapping an elastic ban on the inside of the wrist as a negative reinforcement or punishment. Hypnosis was also recommended by Bornstein (1980) to alleviate excessive nail biting. However, little evidence on their effectiveness has been reported in the literature, thus necessitating the need for further evidence in this field.

6.5 Recommendations and implications

The views and suggestions from the study participants have led to a number of practical implications and recommendations for nail biters, parents of nail biting children, and health professionals regarding how to prevent and treat pathologic nail biting.

Firstly, it was found that psychological imbalances and nutritional deficiency were the top and second most prevalent causes of nail biting as perceived by the participants. Therefore, it is recommended that parents and health professionals pay more attention to these factors while probing for the root causes of nail biting. Additionally, although one or two factors were more prevalent than others, it was widely agreed that nail biting was associated with a wide range of causes and that no single factor fully explained the development of nail biting habit. For this reason, health professionals should utilise a combination of diagnostic approaches, rather than relying on one single approach.

Secondly, the findings indicated the effectiveness of various treatment methods for nail biting from the experiences of nail biters and health professionals, albeit at various levels and to various extents. It seems to be due to the fact that nail biting has multiple possible causes, as supported by the study's findings and many

previous research studies. The effectiveness of each treatment depends largely on how exact the principal cause of nail biting is examined. Mineral supplements were reported as the most effective long-term treatment in this study suggesting that nail-biters have problems with micromineral deficiency. It is worth noting that many nail biters as well as health professionals highlighted, due to the multifactorial nature of nail biting , the need to combine various treatment methods to increase positive results and suggested that treatment combinations be the most advisable approach for treatment of nail biting. Furthermore, there should be some research on nail biting in terms of classifying its severity and the use of standardised treatments.

Thirdly, regarding preventative methods, awareness should be a useful piece of advice to children and parents alike. Accordingly, it is important to highlight the possible consequences or associated health risks and that nail biting could possibly develop into pathology rather than just a harmless habit. In addition, screening for related health issues is a significant step to identifying the underlying causes of nail biting, and thus facilitated the prevention of this habitual disorder. In addition, from a more holistic and naturopathic perspective, a healthy diet is considered as an effective preventative approach, not only for nail biting, but also for other associated health issues. Such a healthy diet should cover a wide range of nutritional food, with the fundamentals being milk, fruits and vegetables.

Fourthly, the study findings found that nail biting tended to commence at a very early age, with some cases as early as three or four years old. In addition, persistent nail biting is normally harder to control. It is therefore suggested that early treatment for nail biting as pathology is necessary, starting as early as possible.

Fifthly, treatment was thought by the study participants to be best on an individualised basis due to the fact that different causes of nail biting would dictate the use of different treatment methods.

Finally, sociocultural factor could play a part in interfering with nail biting habit. It is possible that in some cultures, nail biting is considered as a bad habit which should be avoided or ‘dealt with’, particularly in a school context where children with this

habit tend to receive reprimand from their teachers and ridicule from peers as it is seen as antisocial behaviour, whereas in other cultures nail biting can be considered as a common developmental habit among children and it will disappear when children grow up. Pressure from school authorities and peers can be an interesting factor for future research. Another interesting topic for research in this area is to research nail biting from the perspective of school teachers, particularly in early childhood which is the time when nail biting normally starts. Such as research may focus on aspects such as school policy on nail biting, teachers' attitudes towards nail biting, gender issues in nail biting.

6.6 Strengths and weaknesses of the study

It is virtually impossible to find a perfect study as each has its own purpose, context and challenges with which to deal. The contextual factor of the research environment needs to be taken into account as it could be a facilitating or impeding factor. In other words, it is not simple to measure the success of a study.

This study was conducted with academic rigour in the sense that though it was the researcher's thesis, she did not work alone but with a supervision team to ensure that opinions, suggestions and critical comments were constantly given and taken into account in the research process. Each stage of the research was reviewed to ensure that it was up-to-date and on the right research pathway. A number of presentations, to confirm the rigour of the methodology, the conduct of the study and the conclusions drawn, were conducted by the researcher at symposia, seminars and conferences attended by researchers in the field, staff, and other research students.

Taken into account the personal reflection of the researcher at the end of the research journey, the study has several strengths and weaknesses as discussed below.

Firstly, there was a thorough literature review of the research topic, following which carefully-developed research questions and objectives were formed to fill in the gap of evidence in the field. Based on this, the study has successfully constructed the

conceptual framework to guide the whole study, informing the research design, providing a clear link between the literature and the research questions, as well as reference points for interpreting the data and discussion. Pathologic nail biting can be traced to a wide range of causes, including both psychological and physiological factors. This oral habit is in its turn associated with a variety of health issues, such as damage to teeth and gum, or various types of infections. Regarding treatments, multiple therapies including psycho-behavioural therapy, medication, or mineral supplements have been recommended. It is very important to have a good understanding of the perceptions and experiences of the nail biters as well as health professionals so as to promote better prevention and enhance the effectiveness of treatment methods for nail biting. This study is a very timely research investigation into an important but under-investigated area.

Secondly, the well-structured mixed methods design is another strength of the study. The findings from the quantitative and qualitative methods complement each other. The results from the interviews contribute to validate and confirm the survey results and vice versa. This triangulation design facilitates the validation of data through cross verification from the two quantitative and qualitative sources, which ensures the rigor of the study findings. Apart from that, the study involved the participation of various groups, including nail biters, parents of nail biting children, and a variety of health professionals. Therefore, the data collection gained from different sources allows for the multi-perspective analysis and discussion of findings. In addition, the reliability and validity of the research instruments were carefully checked to ensure the quality of the data.

On the other hand, due to time and budget constraints, the present study has several limitations. By definition, limitations are constraints upon the study that are acknowledged in order to avoid misrepresentation. According to Best and Kahn (2006), limitations are “those conditions beyond the control of the researcher that may place restrictions on the conclusion of the study and their application to other situations” (p. 39). Regarding this study, there are aspects that may limit its generalisability; however, they could generate some ideas for future research directions.

One of the limitations of the study is the use of non-probability convenience and purposeful samplings, which may limit the generalisability of the study. The sample involved in the study might not be fully representative of the larger population of nail biters and health professionals in Tasmania or nationwide. It should be noted that circumstances in the small island state of Tasmania may not adequately reflect those in the rest of Australia. For this reason, the results regarding perceived causes of nail biting, associated health issues, and recommended treatment for nail biting were particular to the current research setting with its contextual characteristics. The possibility of making generalisations beyond the boundaries of this setting was quite limited. However, the insights gained from the current study can be useful for similar contexts. Future research could involve a wider random sampling of the target population to achieve a more robust finding with larger generalisations.

6.7 Future research directions

The previous section also has some specific recommendations for future research. Firstly, the study has strengths and weaknesses in terms of methodological and conceptual rigour. Thus, on this basis there is room for improvement and advancement for future research. The objectives of the study were formulated to address the gaps in the field on the basis of a thorough literature review. As previously indicated, the mixed methods design ensured the breadth and depth of the collected data, producing comprehensive findings from different angles and perspectives. Therefore, it is recommended that the study is replicated in other contexts with similar concerns about excessive nail biting especially among children and teenagers. There will be opportunities to determine whether similar findings are also found in other populations of nail biters if the study is extended. It will also be possible to make a comparative analysis of findings for more robust evidence in this relatively neglected area.

Secondly, as indicated in the weaknesses of the study, its generalisability is quite limited due to the use of opportunity/convenience and purposeful samplings. As a result, future research efforts should involve a wider random sampling of the target population where possible. In addition, the involvement of a higher number of

participants will produce richer data for both quantitative and qualitative phases. Furthermore, the addition of other research instruments such as clinic diaries, and focus groups discussions might enhance data richness and help increase the triangulation of data.

Thirdly, the exploratory and descriptive research design of the study was useful for the current context with a large gap on foundational empirical evidence, especially in terms of the experiences and views of nail biters and health professionals. Once exploratory and descriptive findings have been established, other research inquiries and approaches should be utilised. For example, longitudinal epidemiological studies, experimental designs or randomised controlled trial studies should be conducted to further ascertain the principle causes, associated health issues, and treatment methods of pathologic nail biting.

The study has also identified several knowledge gaps in the field where future research may need to address. The study found that sufferers believe that nutritional deficiency is a very strong candidate for causing nail biting. However, almost no previous medical research evidence has been found regarding this relationship. Therefore, further research to explore if there is a causal relationship between nutritional deficiency and nail biting would be of benefit, and may guide more effective long term prevention and treatment of nail biting. In addition, many recommended treatment methods, such as hypnosis, are not proven by substantial research evidence. Future research efforts might explore the possibility of these low documented approaches.

Another finding of the study was that treating health professionals and sufferers believe a combination of methods should be used to control nail biting. However, it is not clear as to how to combine them effectively in a way that has the support of nail biters, parents of nail biting children and health professionals. A combined treatment framework or course of actions could be a very practical focus for future research in this area.

Finally, in relation to empirical clinical evidences, a randomised controlled trial would be considered a highly reliable methodology in the hierarchy evidence in

therapy. It minimises the potential for bias by randomly assigning participants to either intervention group(s) or a placebo group. As a result, it limits the chance that the incidence of confounding variables (or hidden variables) will differ between the intervention groups and the placebo group.

6.8 Reflection on the PhD research journey

The quality of a research study depends on its validity and reliability. It requires researchers to approach their tasks with absolute objectivity and scientific rigour. Thus, personal presupposition and prejudice should not be allowed to interfere with research. This is the most important factor for assessing their success. However, it is also insightful for readers within and outside the research discourse to understand the background in which the research is situated and the personal research journey that researchers have devoted their energy, enthusiasm, devotion and some affective factors which are present in the research process.

As this is the conclusion of the thesis as well as the research journey that I have been embarking on for over three years (full-time equivalent), it is appropriate for me as the project researcher to reflect on my research experiences, which were both encouraging and challenging. Thus, the grammatical expression will be in first person (i.e., I, my, me).

As a child in rural post war Vietnam, I witnessed my father treating the villagers on a daily basis. Villagers came to my father with all forms of ailments and diseases which I only thought death would be a better option. Despite this thought, I saw light at the end of the tunnel when I gradually understood what my father was actually not only treating patients from their ailments, but teaching them preventative measures in order to prolong their life.

This was where I developed motive and ambition to grow up and work in a health professional field where I could carry on this work my father has shared with me when I was young. This has led me to working in the health profession industry as for the past fifteen years. I have had ample exposure as a practising community

pharmacist to work in this field and applied this skill to assist people with a variety of ailments.

With my Vietnamese background, I have great interest in the Vietnamese language and culture, particularly people's behaviour, attitudes and associated health issues such as physical exercise, eating habit, food security, and public health in general. Among all the common health topics frequently mentioned in the Vietnamese community conversations are eating habit, food reservation and nail biting. During the time the pharmacy course at Monash University, I developed a special interest in community health and was keen to make a contribution to improving health conditions of young children, particularly those from socially disadvantaged communities. I started to participate in several community activities.

After graduation with a pharmacy degree, I have worked as community pharmacist and this has brought me closer to local communities and this is where my interest in nail biting has attracted my curiosity. In discussing my interest in nail biting with a number of health workers, I approached the Graduate Research Coordinator in the Centre of Rural Health, School of Health Sciences at the University of Tasmania and expressed my interest in undertaking a research degree course. I was most pleased that I could embark on my PhD research journey on a topic that has been deeply imprinted in my mind.

While working as a community pharmacist, I have come across many parents who were keen to know why their young children developed nail biting habit and asked me for help with treating this health and social problems. Nail biting is not only seen as a health problem but also a social one as it was perceived as 'bad' habit, hygienically and emotionally. Nail biting is perceived by some parents as a manifestation of dirty habit, nervousness and emotional disturbance.

Now, I have reached the end of my research journey. I realise that when I started to find an answer to nail biting, there are so many windows presenting the further complexity of the topic. The most encouraging reward for me is not just what I have learned from researching this topic, but more importantly the promising research horizon that I dearly want to pursue in the future.

6.9 Conclusion

This chapter has discussed the findings of the study with reference to its research questions, research objectives and the relevant research discourse. The most important findings have been highlighted with explanations and cross comparisons with previous research evidence where appropriate. As indicated at the beginning of the thesis, this study is significant in the sense that it attempted to fill the gap in research dealing with nail biting in Australia. This study provided some insights into nail biting through the relationship between mineral imbalances and nail biting. Finally, the views of the participants were examined to provide a platform on which their voices are recognised and understood in their own contexts. The chapter has also clearly stated the implications of the findings for nail biters, parents of nail biting children and health professionals, before pointing to possible directions for future research. As a whole the study has been a timely research study, contributing significantly to the relevant field where there is paucity in research evidence.

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Appendix 1 Ethics Approval

Social Science Ethics Officer
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HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

26 August 2011

Dr Quynh Le
University Department of Rural Health
Locked Bag 1372
Launceston Tasmania

Student Researcher: Thuy Le

Dear Dr Le

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0012056 - Nail biting in children - related health problems and preventive measures**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 26 August 2011.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Acting Executive Officer

Appendix 2 Questionnaire for parents of nail biters

Nail biting and related health problems: Perspective of health professionals and nail biters

It takes only 10 – 15 minutes to complete. Please tick (✓) the most appropriate box for each of the following questions.

PART A: ABOUT YOUR CHILD

Q1. Your child age……..

Q2. Body Weight: ……. Body Height: ……

Q3. Has your child suffered from nail-biting? Current ☐ Past ☐

PART B: NAIL-BITING AND YOUR CHILD HEALTH

Q4. How many times a day does/did he/she bite his/her nails? (e.g., approximately once a day or five times a day: ……

Q5. How long have your child been biting their nails for? .....

……..

……

Q6. What is your current understanding of the most common cause of nail biting? (Please tick (✓) only ONE of the following boxes on each line).

	True	False	Don't Know
a. Anxiety or nervousness or stress	☐	☐	☐
b. Mineral deficiency (e.g., calcium, iron, magnesium, potassium phosphate)	☐	☐	☐
c. Psychological disorders	☐	☐	☐
d. Poor Diet	☐	☐	☐

Q7. Has your child had the following associated health issues in the past 12 months? (Please tick (✓) only ONE of the following boxes on each line).

	Yes	No	Don't Know
a. Dental problems (gum infection, gum bleeding, toothache, worn teeth, crack tooth enamel, teeth falling out.)	☐	☐	☐
b. Diarrhoea	☐	☐	☐
c. Poor diet	☐	☐	☐
d. Muscle cramps			
e. Eye infection			
f. Inflammation of skin around the nails	☐	☐	☐
g. Parasite/worms	☐	☐	☐
h. Infections	☐	☐	☐
i. Cold and Flu	☐	☐	☐
j. Fungal infection	☐	☐	☐
k. Cold sores	☐	☐	☐

Q8. What treatments have your child tried in the past? (please tick (✓) all of that apply.)

a. Bitter Nail polish ☐
b. Hypnosis ☐
c. Punishment ☐
d. Psycho therapy ☐
e. Mineral supplements ☐ If yes, please specify: .....
f. Medication ☐ If yes, please specify: .....
g. Others ☐ If yes, please specify: .....

Q9. Which treatment did you find the most effective? .....

.....

.....

Q10. What is the estimate amount of milk does your child drink on a daily basis? (e.g., 250ml, 500ml, 1000ml a day): .....

.....

……

……

……

Q11. Is your child a fussy eater (refuses to eat certain food)?

Yes ☐ No ☐

Q12. If yes, please specify a particular food, fruit, vegetables, nuts, beans, your child refuses to eat? (e.g., meat, chicken, beef, apple, beetroot, spinach, zucchini, legumes):

……

……

……

Q13. Is your child taking current taking any medications or supplements? (e.g., vitamins, Minerals, Multi-vitamins (e.g., Pentavite), herbs)

Yes ☐ No ☐

Q14. If yes, Please specify: ……

Q15. Have your doctor diagnosed your nail biting child with the following health issues? (Please tick (✓) the one that appropriate).

	Yes	No	Don't Know
a. Attention deficit hyperactivity disorder (ADHD)	☐	☐	☐
b. Enuresis (Bed wetting)	☐	☐	☐
c. Oppositional defiant disorder	☐	☐	☐
d. Anxiety disorder	☐	☐	☐
e. Tourette Syndrome	☐	☐	☐
f. Depression	☐	☐	☐
g. Joint pain	☐	☐	☐
h. Psychiatric disorder	☐	☐	☐

i. Other health issues (e.g., Sleep difficulty, kidney problem etc.): ☐

(If yes, please specify):……

……

……

……

16. Does your child have any social issues?

Yes ☐ No ☐

(If yes, please specify):……

……

……

Q17. Any other comments/suggestions that you would like to share with us?

……

……

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……

……

……

Thank you for your kind assistance.

If you would be available to participate in a 20-30 minutes follow up interview, please let us know. Please fill in your name and contact details in the next page.

	Yes	No
Would you like to participate in a 20-30 minutes follow up interview?	☐	☐

Your name:……

Your email:…… **Phone:** ……..……..

Appendix 3 Questionnaire for nail biters

Nail biting and related health problems: Perspective of health professionals and nail biters

It takes only 10 – 15 minutes to complete. Please tick (✓) the most appropriate box for each of the following questions.

PART A: ABOUT YOU

Q1. Your age……

Q2. Body Weight: ……. Body Height: ……

Q3. Have you suffered from nail-biting? Current ☐ Past ☐

PART B: NAIL-BITING AND YOUR HEALTH

Q4. How many times a day do you bite your nails? (e.g., approximately once a day or five times a day: ……

Q5. How long have you been biting their nails for? .....

……..

……

Q6. What is your current understanding of the most common cause of nail biting? (Please tick (✓) only ONE of the following boxes on each line).

	True	False	Don't Know
e. Anxiety or nervousness or stress	☐	☐	☐
f. Mineral deficiency (e.g., calcium, iron, magnesium, potassium phosphate)	☐	☐	☐
g. Psychological disorders	☐	☐	☐
h. Poor diet	☐	☐	☐

Q7. Have you had the following associated health issues in the past 12 months? (Please tick (✓) only ONE of the following boxes on each line).

	Yes	No	Don't Know

l.	Dental problems (gum infection, gum bleeding, toothache, worn teeth, crack tooth enamel, teeth falling out.)	☐	☐	☐
m.	Diarrhoea	☐	☐	☐
n.	Poor diet	☐	☐	☐
o.	Muscle cramps			
p.	Eye infection			
q.	Inflammation of skin around the nails	☐	☐	☐
r.	Parasite/worms	☐	☐	☐
s.	Infections	☐	☐	☐
t.	Cold and flu	☐	☐	☐
u.	Fungal infection	☐	☐	☐
v.	Cold sores	☐	☐	☐

Q8. What treatments have you tried in the past? (Please tick (✓) all of that apply.)

h.	Bitter nail polish	☐
i.	Hypnosis	☐
j.	Punishment	☐
k.	Psycho therapy	☐
l.	Mineral supplements	☐ If yes, please specify: .....
m.	Medication	☐ If yes, please specify: .....
n.	Others	☐ If yes, please specify: .....

Q9. Which treatment did you find the most effective? ……

……

……

Q10. What is the estimate amount of milk do you drink on a daily basis? (e.g., 250ml, 500ml, 1000ml a day): ……

……

……

……

……

Q11. Are you a fussy eater (refuse to eat certain food)?

Yes ☐ No ☐

Q12. If yes, please specify a particular food, fruit, vegetables, nuts, beans, you refuse to eat? (e.g., meat, chicken, beef, apple, beetroot, spinach, zucchini, legumes):

……

……

……

Q13. Are you taking current taking any medications or supplements? (e.g., vitamins, Minerals, Multi-vitamins (e.g., Pentavite), herbs).

Yes ☐ No ☐

Q14. If yes, Please specify: ……

Q15. Have your doctor diagnosed you with the following health issues? (Please tick (✓) the one that appropriate).

	Yes	**No**	**Don't Know**
j. Attention deficit hyperactivity disorder (ADHD)	☐	☐	☐
k. Enuresis (Bed wetting)	☐	☐	☐
l. Oppositional defiant disorder	☐	☐	☐
m. Anxiety disorder	☐	☐	☐
n. Tourette syndrome	☐	☐	☐
o. Depression	☐	☐	☐
p. Joint pain	☐	☐	☐
q. Psychiatric disorder	☐	☐	☐

r. Other health issues (e.g., Sleep difficulty, kidney problem etc.): ☐

(If yes, please specify):……

……

……

……

16. Do you have any social issues?

Yes ☐ No ☐

(if yes, please specify):……

……

……

Q17. Any other comments/suggestions that you would like to share with us?

……

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……

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……

……

Thank you for your kind assistance.

If you would be available to participate in a 20-30 minutes follow up interview, please let us know. Please fill in your name and contact details in the next page.

	Yes	No
Would you like to participate in a 20-30 minutes follow up interview?	☐	☐

Your name:……

Your email:…… **Phone:** ……..……..

Appendix 4 Questionnaires for health professionals

Nail biting and related health problems: Perspective of health professionals and nail biters

It takes only 5 minutes to complete. Please tick (✓) the most appropriate box for each of the following questions.

Q1. Your Profession

a. Medical Doctor ☐

b. Pharmacist: ☐

c. Naturopath ☐

d. Other, please specify: ……

Q2. What is your understandings of the most probable cause of nail-biting? Please tick (✓) ONE box on each line.

	True	False	Don't Know
a. Anxiety or nervousness or stress	☐	☐	☐
b. Mineral deficiency (e.g., calcium, iron, magnesium, potassium phosphate)	☐	☐	☐
c. Psychological disorders	☐	☐	☐
d. Genetic	☐	☐	☐
e. Poor diet	☐	☐	☐

f. Other causes, please specify: ……

Q3. Regarding your nail-biting patients, have they had the following associated health issues in the past 5 years? Please tick (✓) ONE box on each line.

	Yes	No	Don't Know
a. Gingivitis	☐	☐	☐
b. Diarrhoea	☐	☐	☐
c. Parasite/worms infestations	☐	☐	☐
d. Frequent viral or bacterial Infections	☐	☐	☐
e. Fungal infection	☐	☐	☐

f. Other, please specify: ……

Q4. Have your nail-biting patients had the following health disorders? Please tick (✓) ONE box on each line.

	Yes	No	Don't Know
a. Attention deficit hyperactivity disorder (ADHD)	☐	☐	☐
b. Enuresis (Bed wetting)	☐	☐	☐
c. Oppositional defiant disorder	☐	☐	☐
d. Anxiety disorder	☐	☐	☐
e. Tourette syndrome	☐	☐	☐
f. Depression	☐	☐	☐
g. Jaw Joint pain (temporo-mandibular joint pain)	☐	☐	☐
h. Psychiatric disorder(s)	☐	☐	☐

i. Other, please specify:

……..

Q5. What treatments would you recommend to a nail biting patient? Please tick (✓) all that apply.

o. Bitter nail polish ☐

p. Hypnosis ☐

q. Punishment ☐

r. Psycho therapy ☐

s. Mineral supplements ☐ If yes, please specify: .....

t. Medication ☐ If yes, please specify: .....

u. Others ☐ If yes, please specify: .....

Q6. Have you been treating nail biting in children very often? Yes ☐ No ☐

Q7. Any other comments/suggestions that you would like to share with us about how to treat and prevent nail biting in children?

.....

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Thank you for your kind assistance.

If you would be available to participate in a 20-30 minutes follow up interview, please let us know. Please fill in your name and contact details in the next page.

If you would be available to participate in a 20-30 minutes follow up interview, please let us know:

Your name:……

Your email:……**Phone:** ……..

Appendix 5 Interview questions for parents of nail biters

Nail biting and related health problems: Perspective of health professionals and nail biters

1. How do you feel when you see your child biting their nails?
2. How persistent were you in trying to discourage his/her biting nails?
3. Have you tried to discourage him/her every time he/she bites nails? If yes, how did you discourage him/her?
4. What did you do when you first notice your child biting their nail? Your reactions?
5. Can you describe what methods that you have tried in the past to stop your child biting their nail?
6. Whom did you seek for advises to help your child nail biting? (Medical Doctor? Psychologist? Psychiatrist? Pharmacist? Naturopaths? Homeopaths? Kineseologist? Nurse? Friends?)
7. What advice have you been given?
8. How did you find their advice? What works and what doesn't work?
9. What treatments have you tried for your child in the past? Was it effective?
10. How hard did you try to find treatment for your child nail biting?
11. How is your child's diet?
12. What seems to trigger or aggravate your child nail biting?

13. Have your family GP diagnosed your child with any medical problems in the past 12 months?

14. What is the most frequent health issue or symptoms have you noticed with your child in the past 5 years?

15. Any other comments/suggestions you would like to add?

Appendix 6 Interview questions for nail biters

Nail biting and related health problems: Perspective of health professionals and nail biters

1. Warm up questions.
2. How persistent were you in trying to stop biting your nails?
3. Can you describe what methods that you have tried in the past to stop you biting your nails?
4. Whom did you seek for advises to help you stop biting your nails? (Medical Doctor? Psychologist? Psychiatrist? Pharmacist? Naturopaths? Homeopaths? Kineseologist? Nurse? Friends?)
5. What advice have you been given?
6. How did you find their advice? What works and what doesn't work?
7. What treatments have you tried in the past? Was it effective?
8. How hard did you try to find treatment for your nail biting?
9. How is your diet?
10. What seems to trigger or aggravate your nail biting habit?
11. Have you been diagnosed with any medical problems in the past 12 months?
12. What is the most frequent health issue or symptoms have you noticed with you in the past 5 years?
13. Any other comments/suggestions you would like to add?

Appendix 7 Interview questions for health professionals

Nail biting and related health problems: Perspective of health professionals and nail biters

1. What is your current understanding of the most probable cause of nail biting in children?
2. How would you diagnose nail biting patients?
3. Would you carry out any diagnostic test? If so, what tests would you normally use?
4. What are you looking for in the analysis tests?
5. If a nail biting children comes to see you for treatments, what advice would you give?
6. What treatments would you recommend to a nail biting patient?
7. If you do not treat the patients whom would you normally refer the patients to? (e.g., psychiatrists, psychologists)
8. What are the experiences do you have with treating nail biting?
9. What would be your recommendations to parents of nail biting children and other health professionals on treatment and prevention of nail biting?
10. Any other comments/suggestions that you would like to share with us?

Appendix 8 Pilot questionnaire checklist

1. How long did it takes for you to complete the questionnaires?..... minutes

2. Did you complete the questionnaire in one session or over two or more sessions? Yes ☐ No ☐

3. How did you find the length of the survey?

   ☐ Fine

   ☐ Too short

   ☐ Long but bearable

   ☐ Too long

4. How did you find the wording of the questions?

   ☐ Fine

   ☐ Easy to understand

   ☐ Too technical. If so, please specify the technical words: ……

   ……

   ☐ Too difficult to understand

5. Did you find any of the questions offensive or too sensitive?

   ☐ No

   ☐ Yes (please specify which question): ……

   ……

6. How did you find the size of the print?

☐ Readable

☐ Difficult to read. If yes, your suggestions for improvement: ……

……

……

7. How did you find the instructions?

☐ Easy/understandable

☐ Hard to understand. If yes, your suggestions for improvement: ……

……

……

8. Did you find the questions are repetitive?

☐ No

☐ Yes (please specify the repetitive questions): ……

……

……

9. Do you have any comments about the survey?

……

……

……

……